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NEWSLETTER

OF THE

NEW ZEALAND MATHEMATICAL SOCIETY

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PUBLISHER'S NOTICE

This newsletter is the official organ of the New Zealand Mathematical Society Inc. This issue was edited by Fabien Montiel and Melissa Tacy. Editorial enquiries and items for submission to this journal should be submitted as plain text or LaTeX files with "NZMS newsletter" in the title of the email to nzmsnews@maths.otago.ac.nz. LaTeX templates are available upon request from the editors.

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The newsletter is available at: nzmathsoc.org.nz/?newsletter

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EDITORIAL

It seems like yesterday that we were writing our first editorial, but indeed 2019 has past quickly and here we are in December. Over the last week the NZMS Colloquium ran at Massey University, Palmerston North. Congratulations and thank you to the organisers, particularly Tammy Lynch the chair of the orgainising committee. Congratulations also to the prize winners, David Simpson (NZMS research prize), Alexander Melnikov (Kalman paper prize) and Martin Kachraty (Aitken student talk prize).

This is a very full issue. Vivien Kirk and Astrid an Huef have updated their headcount of New Zealand women in mathematics and statistics and Mark Wilson has provided us with a primer on open access in research publication. We encourage all our readers to study this, particularly Section 5 "What you can and ought to do". The minutes of the AGM, which was help during the Colloquium last week, are also included in the NZMS notices of this issue.

This year marks the end of Vivien's term as president of our society. On behalf of the New Zealand mathematical community we would like to thank her for her leadership and service over the past two years. Shaun Hendy now steps into the role and we wish him the same success.

Fabien Montiel and Melissa Tacy

PRESIDENT'S COLUMN

2019 was another busy year for the NZMS.

NZMS Colloquia

This year's New Zealand Mathematics Colloquium is hosted by Massey University in Palmerston North. I thank the organisers, especially Tammy Lynch who chaired the organizing committee, for all their work. The 2020 Colloquium will be hosted by AUT University and the 2021 Colloquium will be hosted by the University of Canterbury. Don't forget that the 2023 Colloquium will be held in Auckland as part of a joint meeting with the American Mathematical Society and the Australian Mathematical Society; it is not too early to start talking to overseas colleagues about the possibility of them joining us for the 2023 meeting.

Lecture Tours

Bakh Khoussainov (University of Auckland) was the 2019 Aitken Lecturer and visited the UK in June and July 2019. In addition to giving lectures at various universities around the UK, Bakh delivered the Aitken Lecture at the General Meeting of the London Mathematical Society in June. Bakh's visits were very well received and some reports on his tour can be seen in the latest edition of the Members' Newsletter of the London Mathematical Society at https://www.lms.ac.uk/sites/lms.ac.uk/files/files/NLMS_485_for%20web.pdf.

Lisa Clark (Victoria University of Wellington) has been selected by the London Mathematical Society to be the 2021 Aitken Lecturer and is expected to tour the UK in mid-2021. Congratulations to Lisa for this honour.

The 2020 Forder Lecturer will be Julia Wolf (University of Cambridge). Julia will be in NZ from March 8th to 27th, and will spend several days visiting each university's mathematics department or school. I am grateful to Brendan Cruetz for coordinating Julia's tour.

Student Travel Grants and Other Funding, December 2018 to September 2019

The NZMS awarded student travel grants of over $9000 in total to 11 students. We are grateful to the Kalman Trust for their ongoing support for our student travel grants programme.

The NZMS supported the annual MINZ and NZMASP conferences and provided funding for speakers for the biennial NZAMT conference and the 2019 NZMS Colloquium. We put aside funding to support participation by students and by researchers from the Pacific Islands in the Auckland Algebraic Geometry Conference. We also provided some funding to Maths Craft and made caregiver support grants to Stefanie Hittmeyer and Marie Graff.

Nominating Committee

The Nominating Committee has once again had a busy year identifying candidates for positions, awards and fellowships associated with the NZMS (e.g., NZMS prizes and awards, Fellowship of the NZMS and RSNZ, positions on Council, lectureships, etc). The Nominating Committee does not nominate anyone, but suggests to others that a person might be nominated or encouraged to apply. Individuals are also free to nominate themselves or someone else, independently of the activities of the Nominating Committee. I would like to thank the committee for their sustained work throughout 2019.

NZMS Fellowships

Fellowships are awarded to members of the NZMS in recognition of their contributions to mathematics and their professional standing in the NZ Mathematics community. There are two excellent new Fellows this year: Stephen Joe (University of Waikato) and Rick Beatson (University of Canterbury). Congratulations to Stephen and Rick. I thank the members of the Accreditation Committee for their work in assessing applications and nominations for Fellowship of the NZMS.

NZMS Research Awards and Prizes

The NZMS Research Award recognises excellence in research carried out by mathematicians in New Zealand and is based on research published in the last five years. The Research Award for 2019 went to David Simpson (Massey University) "for combining algebra, analysis, combinatorics, and traditional dynamical systems to make fundamental advances on the bifurcation theory of piecewise-smooth differential equations and maps".

The Kalman Prize for Best Paper is for an outstanding and innovative piece of research in the mathematical sciences published by a member or members of the NZMS. The prize, of value $5000, is generously funded by the Margaret and John Kalman Charitable Trust in recognition of the significant contributions to mathematics in New Zealand made by Professor John Kalman. The 2019 Kalman Prize was awarded to Alexander Melnikov (Massey University) for the journal article "Computable torsion abelian groups", co-authored with Keng Meng Ng, which appeared in Advances in Mathematics, Vol 325, 864–907 in 2018.

The Early Career Research Award was not awarded this year.

The Aitken Prize is for the best contributed talk by a student at the Colloquium. The winner was Martin Bachraty (University of Auckland) for his talk "Skew morphisms of finite groups". An honourable mention was given to Valerie Jeong (University of Auckland) for her talk "A heteroclinic cycle and evolutionary robotics".

I thank the members of the judging panels for their work in assessing the applications and nominations we received for the 2019 Awards and Prizes.

A new award

The Council of the NZMS has resolved that, from 2020, the NZMS will offer a new award, for contribution to the cause or profession of mathematics. For the purpose of this award, "contribution to the cause or profession or mathematics" could include (but is not limited to) contributions to teaching and education, research leadership, outreach, engagement with government bodies, diversity, service to professional societies, mentoring, and communication of mathematics to a general audience.

The award will be known at the Gillian Thornley Award. Gillian had a distinguished career as a mathematician, including a long period at Massey University in Palmerston North. Gillian became the first female President of the NZMS in 1989, and was active in promoting equity and diversity in mathematics. Details about how to nominate someone for the Gillian Thornley Award are available on the NZMS website and will be announced in the NZMS Newsletter in early 2020.

Other Honours

Astrid an Huef (Victoria University of Wellington) was made a Fellow of the Royal Society Te Apārangi for her distinction in research. Jeanette McLeod and Phil Wilson (University of Canterbury) were awarded the Cranwell Medal for Science Communication by the NZ Association of Scientists, for their work founding and running the MathsCraft project. Christian Offen (Massey University) was awarded the Hatherton Award by the Royal Society Te Apārangi, for the best scientific paper by a NZ PhD student in chemical sciences, physical sciences, or mathematical and information sciences. Christian was also selected to be a participant at the Heidelberg Laureate Forum 2019; a short video clip of Christian describing his research, made at the HLF, can be viewed at https://plus.maths.org/content/young-research-0 Congratulations to Astrid, Jeanette, Phil and Christian!

Diversity in the NZ Mathematics Community

The benefits that would result from having more diversity amongst the people who engage with and succeed in mathematics are many, including more equitable access to the activities and careers that require mathematical thinking and the availability of a much larger pool of talented people to work in the mathematical sciences. Despite this having been known for a long time, there is woefully uneven participation in mathematics in all its guises, in NZ and internationally, relative to socio-economic status, ethnicity and gender, as well as a range of other identity factors.

The Council has continued to work this year to support diversity in our Society and the wider mathematics community. Concrete actions by the Council this year include the organization of a panel discussion on diversity

at the 2019 Colloquium and the collection of data of various types, and such activities are useful. However, of more significance is the wonderful work done by individual members of the Society who have been active in their daily practice, trying to change the culture of our institutions, and to encourage, recruit and support students from non-traditional (for mathematics) backgrounds. You know who you are! Thank you for your efforts. If anyone has ideas about how we can do better, individually or collectively, please get in touch.

Education Group

The Education Group within the NZMS has continued its focus on secondary and tertiary level mathematics education. The group has had a particular focus on the proposed changes to NCEA and the subsequent Ministry of Education review of the achievement standards. More information about the work of the Education Group and opportunities to contribute can be found on the Education Group page of the NZMS website.

Membership

The current membership is 257, down slightly from last year's 265; this number includes 57 student members. Please encourage new colleagues and students to join our Society. The first year of membership is free.

Acknowledgements

Many people contribute to the running of the NZMS, and I am grateful to them all. I thank David Simpson for his service as webmaster, John Shanks for his service as Membership Secretary and work on the website, Shaun Cooper for his service as Editor of the NZ Journal of Mathematics, and Melissa Tacy and Fabien Montiel for their service as Newsletter editors.

I am grateful to all the members of the Council for their contributions to the Society. This year we farewell Emma Greenbank, who completed a one-year term as student representative, as well as Emily Harvey and Shaun Cooper, who have both completed six years on the Council and are stepping down. I thank them all for their fine service and wise counsel over their terms.

I am indebted to Rua Murray (Secretary) and Stephen Marsland (Treasurer) who have again put long hours into their roles. Shaun Hendy takes over as President of the NZMS at the Annual General Meeting of the Society in December; I thank Shaun for agreeing to take on this role. Lastly, thanks to the Council and the wider membership for their support over the last two years.

Vivien Kirk

UPDATE TO HEADCOUNT OF WOMEN STAFF IN MATHEMATICS AND STATISTICS IN NZ UNIVERSITIES

Last year the NZMS committed to gather and present data on the gender distribution of academic staff in Mathematics and Statistics in university in NZ. Below we present on 2019 data and compare to last year's data (published in the December 2018 Newsletter)

Methodology

Our methodology has remained the same. We collected data by looking at university calendars and webpages, then asking an appropriate person in each Department or School (usually the head of the academic unit) to check the data we had obtained. We used a census date of March 1st, 2019. Our method of gathering data imposed some restrictions on the type of data we could collect. Specifically: our numbers represent a head count rather than taking into account the FTE of each staff member; we have included fixed-term as well as permanent employees; we did not include emeritus staff or those with honorary contracts; and we used binary gender assignments. We collected data from the following universities: Massey, Auckland, AUT, Waikato, VUW, Canterbury and Otago. We could not find information about Mathematics and Statistic at Lincoln University.

Data

As expected, not much has changed in just one year: overall numbers of women in Mathematics and Statistics remain low, especially at senior levels.

	Maths Women	Maths Men	Stats Women	Stats Men
2018 Postdocs and research fellows	2 (22%)	7 (78%)	4 (33%)	8 (67%)
2019 Postdocs and research fellows	2 (25%)	6 (75%)	5 (50%)	5 (50%)
2018 Tutors and teaching fellows	15 (52%)	14 (48%)	14 (61%)	9 (39%)
2019 Tutors and teaching fellows	13 (46%)	15 (54%)	14 (61%)	9 (39%)
2018 Lecturers (including fixed term)	7 (33%)	14 (67%)	7 (39%)	11 (61%)
2019 Lecturers (including fixed term)	9 (45%)	11 (55%)	9 (45%)	11 (55%)
2018 Senior Lecturers	7 (19%)	29 (81%)	9 (24%)	28 (76%)
2019 Senior Lecturers	4 (12%)	29 (88%)	9 (23%)	31 (77%)
2018 Associate Professors, Readers	6 (27%)	16 (73%)	8 (47%)	9 (53%)
2019 Associate Professors, Readers	8 (33%)	16 (67%)	8 (44%)	10 (56%)
2018 Professors	2 (6%)	34 (94%)	3 (25%)	9 (75%)
2019 Professors	3 (8%)	33 (92%)	3 (23%)	10 (77%)
2018 Total	39 (25%)	114 (75%)	45 (38%)	74 (62%)
2019 Total	39 (26%)	110 (74%)	48 (39%)	76 (61%)

It remains the case that a large proportion of women are employed in teaching-only positions.

	Maths Women	Maths Men	Stats Women	Stats Men
2018 Research required	24 (19%)	100 (81%)	31 (32%)	65 (68%)
2019 Research required	26 (21%)	95 (79%)	34 (34%)	67 (66%)
2018 Research not required	15 (52%)	14 (48%)	14 (61%)	9 (39%)
2019 Research not required	13 (46%)	15 (54%)	14 (61%)	9 (39%)

All university departments now have women staff. The distribution is very unequal across the country: AUT, Auckland and Canterbury have significantly higher percentages of women in Mathematics (29-35%) than the other universities, while Auckland and VUW have significantly higher percentages of women in Statistics (48% and 47%).

	Maths Women	Maths Men	Stats Women	Stats Men
2018 Auckland	15	30	20	25
2019 Auckland	15	28	24	26
2018 Rest of NZ	24	84	25	49
2019 Rest of NZ	24	82	24	50
2018 Auckland as a % of NZ total	38%	26%	44%	34%
2019 Auckland as a % of NZ total	38%	25%	50%	34%

Astrid an Huef and Vivien Kirk

EDUCATION

NZAMT Conference Report

The New Zealand Association of Maths Teachers (NZAMT) holds a conference every two years in locations around NZ. Their 16th conference with the theme *Embracing Ako: Game On* was held on October 1–4 in Lower Hutt and organised mostly by the Wellington Mathematics Association, including Dillon Mayhew, VUW (Victoria University of Wellington). This conference brings together primary and secondary teachers of mathematics and statistics as well as maths education researchers and university mathematicians. It is a great opportunity to hold conversations across these sectors.

The keynote speakers from NZ and Australia showcased a broad view of mathematics and statistics and encouraged teachers to take a wider perspective on these subjects. The opening speaker was Professor Rod Downey, VUW and the Royal Society Te Apārangi's Rutherford Medal winner. He shared the range of his research in discrete mathematics and inspired teachers to help their students see maths as more than just calculus. Dr Jodie Miller, University of Queensland, shared her research on teaching and learning early algebraic thinking using computer programmes like *Scratch*. Leeana Herewini and Ngārewa Hāwera, University of Waikato, shared their research about helping teachers to use rich tasks in kura kaupapa. Anna Fergusson, UoA (University of Auckland), discussed how the world is changing, and the importance of statistics and data science to help to understand this. Anthony Harradine, The Australian Research Council Centre of Excellence for Mathematical and Statistical Frontiers, engaged us with exploring problems that do not necessarily have a known solution, and encouraged multiple ways of viewing and solving them.

Jasmine Hall, a PhD candidate in mathematics at Victoria University, supervised by Prof. Geoff Whittle, was named the Bevan Werry speaker. This means that NZAMT will support her to give talks or workshops with teachers and students around NZ. Jasmine shared her journey into mathematics and how she is motivated by the connection of maths to art and music. She is committed to improving Māori and Pasifika futures, inspired by her grandparents who were teachers in Tonga.

The NZMS sponsored speaker was Associate Professor Catherine Attard, Western Sydney University. She spoke about 'maths engagement'. On engagement for students:
It is only when students are experiencing cognitive challenge, are actively involved and are enjoying and appreciating mathematics, that they are truly engaged (Attard, 2012, p.23).
And on engagement for teachers:
Fully invested in teaching mathematics, work collaboratively with colleagues to design meaningful and relevant tasks, go beyond the minimum requirements of delivering curriculum, and genuinely enjoy teaching mathematics in a way that makes a difference to students (Attard, 2017).

In one keynote timeslot the organisers gave time to the three national mathematics and statistics organisations, the NZMS Education Group, the NZ Statistics Association, and the NZ Association of Mathematics Teachers. Cami Sawyer (Massey U, Education group convenor) represented NZMS and was able to publicise the work of the NZMS Education Group. In particular, she shared that the group takes an active role in NZ mathematics education with a dual focus on the tertiary sector and the secondary-tertiary transition, and she highlighted the work of the members of the group—particularly those presenting at NZAMT.

Teachers, industry representatives, and academics, presented a variety of workshops throughout the week. Members of the NZMS Education group presented a range of workshops that were all well received. In particular:

- Julia Crawford (Cognition Education), *Number sense to algebra* and *Student self-assessment in mathematics*;
- Dillon Mayhew (VUW), *Outreach experiences as a Bevan Werry speaker*;
- Peter Bier (UoA), *What makes a good problem solver? Lessons from a decade of the NZ Engineering Science Competition* and *The Mathematics of Juggling*;
- Rachel Passmore (UoA) and Cami Sawyer (Massey U), *Transition to Tertiary Study: Can we do better?* and *Reimagining Level 3 Maths and Calculus*;
- Kerri Spooner (AUT), *Mathematical Modelling in the classroom*; and
- Rebekah Ward and Cami Sawyer, *Real Maths in your classroom? Consider useful mathematical modelling frameworks and try a Desmos activity*.

The conference provided many opportunities to meet and hold discussions with teachers from all over NZ. We would encourage you to make the effort to participate in their future conferences. The next NZAMT conference will be held in New Plymouth, hosted by the Taranaki Maths Association.

Cami Sawyer

References

Attard, C. (2012). Engagement with mathematics: What does it mean and what does it look like? Australian Primary Mathematics Classroom 17(1), 9–13.

Attard, C. (2017). Are you an engaged teacher? (Blog Post). Retrieved from https://engagingmaths.com/2017/05/23/are-you-an-engaged-teacher/

Teaching Excellence Awards

Peter Bier (left) and Cami Sawyer, both members of the NZMS Education group, have received 2019 Tertiary Teaching Excellence Awards from the Ako Aotearoa National Centre for Tertiary Teaching Excellence. These awards recognise teachers who have demonstrated commitment and support for learners that go far beyond good teaching practice.

Peter Bier

Peter Bier's unorthodox teaching methods of juggling and riding a unicycle while delivering mathematics lectures serve a serious purpose—his passionate belief in helping students learn and succeed.

Peter is a Professional Teaching Fellow within the Department of Engineering Science at the University of Auckland's Faculty of Engineering. He teaches into core Engineering Mathematics courses and is involved in every aspect of teaching within the University, even if that means going back to class himself.

"Our Physics Department introduced a 'flipped-classroom' environment and I really wanted to know how that worked, so I enrolled in a stage one physics course learning alongside other students."

In his own classes he typically lectures to over 500 students at a time and introduces an element of performance to help keep students engaged. He uses a wide range of props from balls to clubs, ropes, balloons and umbrellas, in order to demonstrate the complex mathematics-based principles of engineering. "By bringing dynamism, energy and enthusiasm to my teaching and blending real-world examples and active learning, I can create a highly engaging learning environment," he says. "My goal is to take students from where they are, to where they need to be."

An essential feature of Peter's teaching is that he tends to avoid more orthodox lecture delivery methods such as Powerpoint in favour of a 'messy' approach, with problems worked out live, right in front of students. "People don't solve problems by using Powerpoint slides, they sketch diagrams and work through equations by hand or with the help of sophisticated software."

One of his strongest beliefs is that students need good guidance as they make the transition from secondary school to tertiary study. He helps promote secondary students' interest in STEM via a nationwide mathematical modelling competition for teams of senior secondary students. The NZ Engineering Science Competition attracts around 200 teams each year and sees students spending a whole day grappling with solving a real-world problem.

He also takes an active role in training university stage one clinic tutors, designs online diagnostic quizzes for rapid feedback and uses real-world stories that he hopes will resonate with students to help them adjust.

"Good teachers foster a love for a subject and a life-long love of learning, and ultimately everything I do is focused on achieving that."

Cami Sawyer

Cami is a senior mathematics tutor within the School of Fundamental Sciences at Massey University. The emphasis of Cami's teaching is on reshaping teaching mathematics by distance. She teaches a wide range of students from teenagers and international students to learners with families and full-time jobs. She says that it is important to recognise that most distance students fit study in between other demands on their time, and that most of her communication with them is asynchronous.

She was also an early adopter of using video to teach in a creative way. Her videos are not recordings of internal lectures, but bespoke teaching sessions, structured to help the learning of distance students. Since 2015, Cami has produced over 185 videos which have had over 65,000 views. She says, "What do you see when you see a written solution to a maths problem? Many students see it as a complete thing—it is all there—it is done. When mathematicians see it, they see it as evolving; being created. Video allows me to bring the motion and the creation of problem-solving to students. It also allows students to take the time they need to see the problem unfold. They can pause and spend as much time as they need to on a step. I encourage them to pause, to think about what they would do next, and to find their own approach."

While Cami teaches across many of the University's programmes and degrees, her outreach extends far beyond Massey. She has been helping to develop a national profile by convening the NZMS Education Group for the last three years. "We are working to build a consensus around needed changes in the teaching of mathematics at secondary and tertiary level, but improvements do not happen easily. We need to improve outcomes for all students, but particularly Māori students who can be underserved by our current system."

Her teaching philosophy is based in Situated Learning Theory, where teachers and learners are active participants in the learning process. "I encourage students to make connections with earlier learning experiences and overcome barriers they may have created to learning maths, and identify how maths connects to their future goals," she says. "For me, teaching is a craft to be worked on and improved—the process is never complete. Each semester is another opportunity to enhance the learning experience. Excellent teaching is about recognising students as individuals, and helping them make connections throughout their learning."

Cami recites the whakataukī: *Ehara taku toa, he takitahi, he toa takitini* (My success should not be bestowed onto me alone, as it was not individual success but that of a collective.)" Cami would like to thank her colleagues at Massey University, especially Christine Burr and Tammy Lynch, as well as the NZMS Education group, who help, challenge, nurture, and inspire her.

Congratulations Peter and Cami!

The NZMS Education Group

MATHEMATICAL MINIATURE

MM49:A puzzle and a meta-puzzle

Part 1

I received a nice solution to the Diophantine equation introduced in MM47

$$\begin{bmatrix} a & b & c \end{bmatrix} M \begin{bmatrix} a \\ b \\ c \end{bmatrix} = n^2, \quad \text{where} \quad M = \begin{bmatrix} 1 & -1 & -1 \\ -1 & 1 & -1 \\ -1 & -1 & 1 \end{bmatrix}, \tag{1}$$

from Jörg Hennig (Otago) and the following discussion of this problem is inspired by him. First note that

$$M = \begin{bmatrix} 1 \\ -1 \\ -1 \end{bmatrix} \begin{bmatrix} 1 & -1 & -1 \end{bmatrix} - \begin{bmatrix} 0 & 0 & 0 \\ 0 & 0 & 2 \\ 0 & 2 & 0 \end{bmatrix}$$

so that (1) becomes

$$(a-b-c+n)(a-b-c-n) = 4bc. \tag{2}$$

The two factors on the left of (2) have the same parity, which must be even because of the factor 4 on the right. Write $p = (a-b-c+n)/2$, $q = (a-b-c-n)/2$ and the problem becomes

$$pq = bc.$$

with general solution

$$p = \alpha\beta, \quad q = \gamma\delta, \quad b = \alpha\gamma, \quad c = \beta\delta$$

leading to

$$\begin{bmatrix} a & b & c \end{bmatrix} = \begin{bmatrix} (\alpha+\delta)(\gamma+\beta) & \alpha\gamma & \beta\delta \end{bmatrix}, \quad n = \alpha\beta - \gamma\delta,$$

By a "non-trivial common factor" I will mean a "common factor other than ± 1". To eliminate cases in which a, b and c, have a non-trivial common factor, which could be cancelled to obtain a simpler solution, we need to require that no three of α, β, γ and δ share a non-trivial common factor.

Part 2

I am fortunate enough to be on the mailing list for the INMS Newsletter from Massey University, for which Graeme Wake provides a Puzzle Corner. Some of his puzzles are easy, some are hard, but they are all interesting.

One of his puzzles was to show that $N = 989 \cdot 1001 \cdot 1007 + 320$ is a composite number. Evaluate N modulo 991 to obtain $(-2) \cdot 10 \cdot 16 + 320 = 0$, so that 991 is a factor and N cannot be prime. To find the prime factorisation of N, write $x = 991$ so that

$$\begin{aligned} N &= (x-2)(x+10)(x+16) + 320 \\ &= x^3 + 24x^2 + 108x \\ &= x(x+6)(x+18) \\ &= 991 \cdot 997 \cdot 1009. \end{aligned}$$

Part 3

The meta-puzzle is to construct puzzles like the one in Part 2. Essentially, this is to find integers a, b, c so that, when the constant term in $(x+a)(x+b)(x+c)$ is deleted, the remaining polynomial has integer zeros. This means that the discriminant of

$$x^2 + (a+b+c)x + (ab+bc+ca)$$

is a perfect square, which will be denoted by n^2. This gives

$$(a+b+c)^2-4(ab+bc+ca)=n^2,$$

which is equivalent to (1).

J.C. Butcher

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CYBERMATH

Research publishing for the nonexpert

Since the first scholarly journals were started in 1665, there has never been a time when all was right with academic publishing. However over the last several decades, many changes have occurred, and the stresses and contradictions in the system have become starkly apparent. Economic issues are key: the journal market currently involves

- non-substitutable goods (papers, journals);
- oligopoly (by large publishers such as Elsevier);
- anticompetitive bundling ("Big Deal" subscription packages);
- excessive rents (profit margins higher than Apple);
- privatization of public property (who pays those who write the papers and do the refereeing and editing?);
- unsustainable price increases (the "serials crisis");
- perverse incentives (e.g. Other People's Money being spent).

I recommend that nonexperts first read the Guardian article by Stephen Buranyi [1] in order to better understand how the scholarly publication system evolved to the mess it is today. There are many actors in the system, including authors, referees, editors, readers, administrators, publishers, libraries, learned societies, research funders; they all have different incentives, and this makes change tricky. My overall opinion is that it is impossible to achieve a properly functioning market for scholarly publishing, and that a public good model is more appropriate.

Publishing models

The traditional model from the print world of last century is *subscription*, as used by newspapers and magazines. Another widely used name is *paywall*. This model has been used by all kinds of journal publishers. *Open access* refers to the model of articles being free to read for everyone (having an internet connection). There are various types of Open Access (OA):

- *green OA* refers to self-archiving by authors, possibly with help from university repositories;
- *gold OA* refers to journal publications.

Funders are strongly in favour of OA, since they want the research they pay for to be disseminated as widely as possible. There is substantial evidence that the obvious guess, namely that open access articles are cited more than subscription articles, is correct. It is hard to find anyone opposed to open access *per se*: arguments typically centre around how urgent it is, whether it can be paid for, and concerns about potential bad behaviour by publishers.

Green OA has drawbacks: it typically does not involve the "version of record", but an earlier version of the article; it is dependent on publisher goodwill. It often does not come with rights to reuse, redistribute and in some cases adapt material (such as granted, for example, by Creative Commons licences).

Gold OA usually involves clear reader rights specified by a CC licence, and comes in two main flavours. Costs of publication must be paid somehow. One model is *author-pay* whereby an APC (Article Processing Charge) is levied at time of publication. The author must either pay directly, have rich friends (e.g. their university, research grant funder) pay, or beg for a waiver (usually granted only if the author's country is considered sufficiently poor). The APC model is currently very popular with established commercial publishers and with scam artists (these sets are not necessarily disjoint). It is very unpopular with authors and with institutions that are not well-funded (that is, most of them).

No-fee ("diamond" or "platinum" OA) journals outnumber APC journals, but are typically smaller, and run by academic volunteer labour, often with a little IT support from their institutions. Other business models exist (e.g freemium) but are relatively little used.

Examples of mathematical journals:

- Annals of Mathematics: subscription, owned by Princeton University.
- Antarctica Journal of Mathematics: pay to read AND to submit; an obvious and complete scam run from India
- Journal of Algebra: subscription, owned by Elsevier
- Bulletin of the London Mathematical Society: subscription, published by Wiley, owned by London Math Society
- Forum of Mathematics Pi, author-pay OA, owned by Cambridge University Press
- Electronic Journal of Combinatorics: no-fee OA (explicit reuse licence), informal ownership by the editors
- New Zealand Journal of Mathematics: no-fee OA (no licence), owned by NZMS and University of Auckland
- Advances in Combinatorics: no fee OA (explicit reuse licence), owned by Alliance of Diamond Open Access Journals (run by Timothy Gowers), supported by Queen''s University Library. An *arXiv overlay journal* (all papers are submitted via arXiv and the final published versions are also hosted there).

To formalize the intuition of "community-controlled free journals" I was involved in formulating the "Fair Open Access Principles":

- The journal has a transparent ownership structure, and is controlled by and responsive to the scholarly community.
- Authors of articles in the journal retain copyright.
- All articles are published open access and an explicit open access licence is used.
- Submission and publication is not conditional in any way on the payment of a fee from the author or its employing institution, or on membership of an institution or society.
- Any fees paid on behalf of the journal to publishers are low, transparent, and in proportion to the work carried out.

These are core principles for organizations such as Free Journal Network and MathOA. Of the journals listed above, Elec. J. Comb. and Adv. Comb. satisfy these, although the ownership could be clarified; NZJM only fails the licence condition and I hope to rectify that by 2020.

Other important issues

Apart from access to research articles, there are many areas where the current system needs improvement. These include:

- correctness and reproducibility of published research (e.g. open access to raw research data, adequate pre-publication refereeing);
- transparency and fairness of the refereeing and editorial process (e.g. how conflicts of interest are dealt with);
- ability to innovate (e.g. papers in XML format for mobile device viewing, postpublication review, data mining of publications).

Despite the claims of large for-profit publishers, their performance in these areas has been mediocre. This is hardly surprising given the lack of competition they have faced. For example, commercial publishers often outsource copyediting and typesetting, and the quality of the LaTeX produced is rather often worse than that supplied by the author!

Current developments

Plan S was launched in 2018 by a coalition of European research funders, and aims to accelerate the large-scale conversion to open access by mandating that "all scholarly publications on the results from research funded by public or private grants provided by national, regional and international research councils and funding bodies, must be published in Open Access Journals, on Open Access Platforms, or made immediately available through Open Access Repositories without embargo". So-called *transformative agreements* are encouraged by Plan S, and several have already been signed. They often have the name "read and publish" or "publish and read", and involve a large fee being paid by an institution to a publisher to allow all authors from that institution to publish gold OA. Commercial publishers have attempted to double-dip by forming hybrid journals, whereby they receive APCs *and* subscription payments, but Plan S forbids these.

Many observers, including me, believe that such deals will only entrench the power of the large commercial publishers and that the payments agreed to so far are too high. Such agreements are particularly troublesome for learned societies used to relying on large subscription income to cross-subsidize their other activities (the NZMS does not do this).

The way forward?

It seems obvious that given the amount of money spent worldwide on subscriptions (estimated at US$5000 per paper), it is desirable to move to a system whereby libraries and research funders reallocate subscription money to pay production costs of OA journals directly. This has in fact been tried in some cases, including SCOAP3 in physics and the Open Library of Humanities. Costs of production are less than $1000 and mostly less than $100 per paper; although SCOAP3 overpays substantially, it is still better than the old subscription system.

I believe that cost controls and price transparency with commercial publishers are so weak that the current ownership situation cannot lead to the outcomes we want and need as a research community, and only journals run according to the Fair OA Principles are acceptable. Publishers may still have a role in providing services even in the 21st century, but the journal brand, built up over decades by authors, editors and referees (and very little by publishers) should be owned by the research community. Many of the older scholar-run OA journals (dating back to the 1990s) have uncertain ownership status and it is best to clarify this legally. Many newly founded Fair OA journals (such as Quantum, my standard example of best practice in almost every area) are owned by legally constituted nonprofit organizations. Of course, doing everything properly requires some time and money, which is why I write $100 and not $0 above comes from, but this amount of money is easily covered for many such journals by a fraction of a single library's current subscription spending. It is then fairly clear where we are now, and where we want to be: how to get there rapidly and efficiently is currently a hotly debated issue.

What you can and ought to do

Improving the current situation is not easy, given the multiplicity of agents and incentives in the global publication system. However, we can all do something. Waiting for others to solve the problem is unlikely to work well.

- As an author, submit to journals that are free to read, ideally those following the Fair Open Access Principles, or failing that, journals that are reasonably priced and owned by scholarly societies. It can be difficult to determine ownership status. Post your paper on an established preprint server (e.g. arXiv.org) just before journal submission, and update it with the latest version you legally can once accepted (don't duplicate work by putting papers on your own website unless you really want to). Prefer to submit to journals not owned by Elsevier, Springer, Wiley or Taylor & Francis. Don't sign away your copyright to a publisher, or if you must, revise the copyright form to ensure that you have the right to post publicly the accepted version of the manuscript (and then do it!). Consider signing various open statements, petitions and boycotts aimed at steering the system toward community-owned journals run according to Fair Open Access Principles.

- As a referee, refuse to donate your free labour to "bad" journals. There are plenty of better ones you can work for. Many of us are overworked with refereeing in any case. Politely make it the editor's problem for supporting that journal. Some templates for refusal letters are linked below.

- As an editor, talk to your fellow editorial board members about jumping ship (as done recently by *Algebraic Combinatorics*). Contact MathOA for legal and practical advice and other support. Don't sign a contract

from the publisher without reading it or getting advice from MathOA. Realize that a few thousand dollars a year may be nice, but think where that money is coming from: market power exercised against underfunded public institutions of higher learning.

- As an administrator, sign DORA and actually implement it in your institution. Do not allow important personnel decisions to be made based only on where papers are published, thereby outsourcing academic judgment; insist that evaluation committees actually read papers. Follow the University of Liège and Italy's Ministry for Public Education in requiring all publications considered for internal promotions and performance reviews to be open access.

- As a decision-maker in a library, allocate increasing fractions of your budget and staff time toward supporting the global OA infrastructure. Contact organizations such as Free Journal Network to see how you can help. Join Subscribe to Open. Join University of California and others in cancelling Big Deal subscription bundles. Resist the temptation to sign big multi-year "Publish and Read" deals. Raise these issues clearly with your library consortia.

- As an officer of a learned society, ensure that you use only publishers that are efficient and provide good quality service (almost always this means not the large ones). Contact your library subscribers and ask them to "Subscribe to Open". Realize that money you receive from journal subscriptions via a large commercial publisher is mostly subsidized by non-members and the research is locked away from the public; ask your self whether that is really consistent with the whole point of your society (spoiler: it isn't). Consult the site "Transitioning Society Publications to OA" to investigate converting your journal to a no-fee OA model.

- As a research funder, mandate that all work produced with your funding be immediately open access on publication. Consider signing up to Plan S but be wary of the pull toward the APC model. Try to support no-free OA journals directly.

- As a reader, every time you come to an unnecessary paywall, let the author know about it with a quick email. Use Unpaywall browser extension to locate free versions (52% of papers are legally available online for free, apparently). Use SciHub or other sites of questionable legality if and only if the paper is important. If the paper is not that important and can't be easily read, treat it as if it doesn't exist!

- As a citizen, let your politicians know that this issue is important. Many countries have Open Government and Open Data policies for government. Pursue an extension of this to cover all research outputs from publicly funded institutions, at least.

Tools and further resources

- Authors:
  - Free Journal Network https://freejournals.org
  - Directory of Open Access Journals: https://doaj.org/
  - Publisher copyright and self-archiving policies: http://sherpa.ac.uk/romeo/index.php
  - SPARC copyright addendum: https://sparcopen.org/our-work/author-rights/brochure-html/
- Referees:
  - Template letters for refusing to referee for "bad" publishers: https://gitlab.com/publishing-reform/discussion/blob/master/Resources/letter-templates/refusal_to_referee.md
- Editors:
  - MathOA: http://www.mathoa.org/
- Administrators:
  - Declaration on Research Assessment: https://sfdora.org/
- Librarians:

  - Subscribe to Open https://www.annualreviews.org/page/subscriptions/subscribe-to-open-faq
  - Fair Open Access Principles https://www.fairopenaccess.org

- Learned societies:
  - Transitioning Society Publications to Open Access https://tspoa.org/
  - Martin Eve's plan for converting society publications to OA https://eve.gd/2018/01/21/how-learned-societies-could-flip-to-oa-using-a-consortial-model/

- Research funders:
  - Plan S https://www.coalition-s.org/

- Readers:
  - Google Scholar http://scholar.google.com
  - Unpaywall browser extension https://unpaywall.org/products/extension

- Citizens:
  - Who needs access? You need access! https://whoneedsaccess.org/

References

[1] S. Buranyi, "Is the staggeringly profitable business of scientific publishing bad for science?", In: *The Guardian* (June 27, 2017), URL: https://www.theguardian.com/science/2017/jun/27/profitable-business-scientific-publishing-bad-for-science (visited on 24/11/2019).

Mark C. Wilson

MATHEMATICAL MISEPONYMY

Carmichael Numbers

Recall Fermat's Little Theorem (FlT): if p is prime and $0 < m < p$ then $m^{p-1} \equiv 1 \bmod p$. FlT provides a way of testing whether an integer is prime, but we might ask whether there are composite numbers that satisfy the same sort of congruence relations. A *Carmichael number* is a composite integer n such that $m^{n-1} \equiv 1 \bmod n$ whenever $0 < m < n$ and m is relatively prime to n. These numbers are named for the American mathematician Robert D. Carmichael, who discussed in [1] a number of congruence relations like that above and included several of the numbers named for him (see [1, p. 238]). A list of the first 33 Carmichael numbers may be found at https://oeis.org/A002997, but it is known that there are infinitely many. The first few Carmichael numbers are 561, 1105, 1729, 2465, 2821, 6601.

A decade before Carmichael's discussion, in 1899, Alwin R. Korselt obtained a condition equivalent to a number being Carmichael, announcing it in [2]. It seems worthwhile including Korselt's entire comment which is one of several responses to a problem addressed in a previous issue of *L'Intermédiaire des Mathématiciens*. The problem appears to have asked readers to show that $2^n - 2$ is not divisible by n when n is composite. Here is a free translation from the original French.

> The Chinese problem is a false proposition because the expression $\frac{2^n-2}{n}$ is an integer for $n = 3.5.43$. Moreover I have shown that $\frac{a^p-a}{p}$ is an integer for any integer a only if:
>
> 1° The factors of p are all simple (non quadratic);
>
> 2° $p-1$ is divisible by $V(p_1-1, p_2-1, \ldots, p_n-1)$ where $p_1, \ldots, p_n$ signify the prime factors of p and $V(p_1-1, \ldots, p_n-1)$ is the least multiple of $p_1-1, \ldots, p_n-1$; these conditions are sufficient.

Condition 2° could just as well demand that each of $p_1-1, \ldots, p_n-1$ divides $p-1$. As an example, since the Hardy-Ramanujan taxi number 1729 factors as $7 \times 13 \times 19$, Korselt's criterion makes it easy to verify that 1729 is Carmichael: 6, 12 and 18 (or, if you prefer to work it out, 36) all divide $1728 = 2^6 \times 3^3$. (Note that Korselt's criterion ensures that every Carmichael number is odd: a square-free, even, composite number n must have at least one odd prime factor p but then Korselt's criterion would require the even number $p-1$ to divide the odd number $n-1$.)

Both Korselt and Carmichael were beaten to these numbers by Václav Šimerka, [3]. My familiarity with the Czech language (as used both in 1885 and today) is non-existent but there are enough mathematical formulae, etc, in [3] for me to see that Šimerka is working in the context of FlT: indeed [3, Section 9] begins with a quick proof of FlT and ends with a list of the first seven Carmichael numbers. Contrast with Carmichael, who listed only the first, second, fifth and ninth of "his" numbers.

References

[1] R. D. Carmichael, *Note on a new Number Theory Function*, Bull. Amer. Math. Soc., 16(1910), 232–238.

[2] A. R. Korselt, *Problème chinois*, L'Intermédiaire des Mathématiciens, 6(1899), 143.

[3] Václav Šimerka, *Zbytky z arithinetické posloupnosti*, Časopis pro pěstování mathematiky a fysiky, 14(5), (1885), 221–225.

David Gauld

PROFILE

Sina Greenwood

A few months after her family migrated from Samoa, Sina Greenwood was born in Whanganui. The family remained in Whanganui for about nine years before moving to Auckland. On completing her BSc degree from the University of Auckland she worked in Canberra for a couple of years then followed a short stint of secondary teaching at Avondale College, Auckland.

Sina returned to studies, and her MSc with First Class Honours was followed by a PhD in Topology with David McIntyre and me. Some of her time as a PhD student was also spent as a research assistant for me and as a temporary lecturer in the Auckland Mathematics Department. By 1999 she had completed her PhD thesis and graduated as the first PhD graduate in Topology from the University of Auckland, https://genealogy.math.ndsu.nodak.edu/id.php?id=29542. Actually she was first equal: amazingly there were three other PhD graduates in Topology at the University who graduated at the same ceremony as Sina: Jiling Cao, Abdul Mohamad and Tsukasa Yashiro.

Sina's temporary lectureship was followed by a New Zealand Science and Technology Post-Doctoral Fellowship 2001–2004 at the end of which she was appointed as a permanent lecturer in the Department of Mathematics[1]. Since then she has risen through the ranks and is now an Associate Professor.

Sina's PhD thesis involved studies in Set-Theoretic Topology, with a large part of it devoted to the construction of a non-metrisable manifold from a particular type of uncountable tree. She has maintained her interest in huge manifolds while branching out to topological connections with Analysis. However her most recent interests have turned towards Dynamics and Generalised Inverse Limits where she has built up significant international collaborations and pushed the boundaries of research to the point where the Marsden Council awarded her a three year grant late in 2018. We can expect many more great outcomes from her work especially in these two areas over the next few years as her visits to collaborators and their visits to Auckland intensify.

On a personal note, as Sina's most frequent co-author and vice-versa, I would like to record what a pleasure it has been to undertake joint research with her, to marvel at her insight and tenacity as we work towards our goal. Does she ever turn off completely? Maybe not. I recall her morning announcement of an answer to a problem that had been hassling us for some time, even the previous evening, when we were at a conference in North Bay, Canada. Shift to a conference in Longyearbyen, Svalbard, where Post-Doctoral Fellow Greenwood was sipping her morning coffee while a bunch of more established topologists were grappling nearby with a challenging problem involving imposing a compact Hausdorff topology on a given set so that a given self-function on the set is continuous. Sina happened to hear some of their frustration, solved the problem while still making her way through her coffee and showed them how to overcome their obstacle before the next round of conference talks began. So began a successful venture into Topological Dynamics that continues to this day.

[1] Curiously her PDF ran for one day short of three years, so Sina must have the almost unique distinction of starting her permanent position on 29th of February. Someone must have overlooked that 2004 was a leap year!

Sina has also been a very successful teacher. Some of her innovations have even been adopted by others unaware of who started it all. One of her special teaching innovations is an adaptation of a method of teaching used by Robert Lee Moore and involving active participation, including presentations, by students in the development of mathematical ideas. She has developed successful courses, especially in Topology and Logic & Set Theory, and I have had the privilege of lecturing using her clearly presented Logic notes.

As a Samoan Sina has had a major role in helping establish and run programmes to help Pasifika students have a more successful life of studies. She was the driver behind the establishment of systems in the Mathematics and Statistics Departments then later her ideas spread across the University. She has served both as an ordinary member and as chair on a number of University committees aimed at enhancing the University experience of Pasifika (and Maori) students. Currently she is Associate Dean Pacific for the Faculty of Science.

She has received Faculty and University awards for sustained excellence in her promotion of equity and was the driving force behind activities that led to the Mathematics Department as a whole receiving a special award from the University. Appropriately she was elected a Fellow of the New Zealand Mathematical Society in 2018.

David Gauld

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING, COMPUTER AND MATHEMATICAL SCIENCES

Events

On 21-22 November, the Mathematical Science Research Group (MSRG) hosted the 6th annual AUT Mathematical Sciences Symposium. This was a joint effort of Prof Jiling Cao and Drs Sarah Marshall, Victor Miranda, Nuttanan Wichitaksorn and Wenjun Zhang. The symposium focuses mainly on some areas in Applied Mathematics and Analytics/Statistics. This main purpose of this annual event is to develop and promote opportunities for AUT academic staff working on these areas to collaborate with colleagues from other universities. Over 50 delegates attended the event, with around 30 talks across areas of statistical programming, statistical methodology, stochastic modeling, data science, computational and mathematical modeling, financial analytics, financial mathematics, decision analysis, and structural dynamics.

The six plenary speakers of the 2019 MSRG Symposium at AUT are:

- Boris Choy, University of Sydney, Australia
- Simona Fabrizi, University of Auckland, New Zealand
- Rachel Fewster, University of Auckland, New Zealand
- Andreas W. Kempa-Liehr, University of Auckland, New Zealand
- Fabien Montiel, University of Otago, New Zealand
- Thomas Yee, University of Auckland, New Zealand

Travel and Conference Participation

Over the period 8-13 November, Prof Jiling Cao attended the 3rd Pan-Pacific International Conference on Topology and Application, hosted by Sichuan University, China. He was the Chair of the International Organizing Committee. Prior to this conference, Jiling also visited Minnan Normal University. The Pan Pacific International Conference on Topology and Applications is a biennial conference. The first conference was hosted by Minnan Normal University (Zhangzhou, China) in November 2015, and the second conference was hosted by Busan National University (South Korea) in November 2017.

Prof Jiling Cao, Drs Hyuck Chung, Michael Lockyer, Catherine Hassell Sweatman and Wenjun Zhang participated in the New Zealand Mathematical Society Colloquium, 3-5 December 2019, held at Massey University, Palmerston North, where each of them presented talks about their recent research work.

Dr Hyuck Chung visited University of Otago in November to continue his work with Dr Fabien Montiel and A/Prof Colin Fox. They have been working on wave motions of elastic structures interacting with air or water.

In July, Dr Farida Kachapova presented the paper entitled "Convergence theorems in an equilibrium interaction model" at the 27th International Conference on Statistical Physics, StatPhys27, Buenos Aires, Argentina.

PhD candidate Shu Su attended the Quantitative Methods in Finance 2019 Conference held on 17-20 December 2019 in Sydney. The conference brought together leading experts in quantitative finance industry and academia in Australia and New Zealand. Su presented a talk on her recent work of "*Pricing VIX Derivatives with Infinite-Activity Jumps*".

Wenjun Zhang

UNIVERSITY OF AUCKLAND

DEPARTMENT OF MATHEMATICS

Staffing

Members of the department attended the funeral of former member of the Mathematics Department, Wayne Walker.

Anna Barry has resigned.

Ofer Marmur has accepted a lecturer position in Mathematics Education.

Seven staff have been on sabbatical this semester, which means the rest of us have been doing more than average teaching and marking.

Grants, prizes and awards

Bernd Krauskopf and Rod Gover were both awarded Marsden grants.

Staff in the Mathematics Department were awarded the following grants in the Faculty of Science internal research funding round:

- Marie Graff "Wave propagation phenomena and related inverse problems for imaging and signal processing"
- Arkadii Slinko "Mathematics of Condorcet Domains"
- Jeroen Schillewaert and Marston Conder "Geometry and Symmetry"
- Shayne Waldron "Approximation on the unit sphere"

Igor Kontorovich has been awarded a Learning Enhancements Grant of $20,000 from the University of Auckland for the project "Enriching teaching and learning affordances of Canvas with Computer Algebra System".

James Sneyd was awarded an NIH (NIDCR) grant "An experimental/computational approach for understanding salivary fluid secretion", with co-PIs is David Yule (U. Rochester, USA).

Jeroen Schillewaert was awarded a grant from the Sydney Mathematical Research Institute Visitor Program for a visit during his sabbatical in late 2020.

PhD student Kevin Stitely won a best poster award at the recent International Conference on Laser Spectroscopy (ICOLS) in Queenstown.

Major visitors

Dustin Mixon (Ohio State) is visiting Shayne Waldron on a Kalman Visiting Fellowship.

Sione Ma'u is organising the conference '"Algebraic Geometry in Auckland" on 16-20 December, 2019. More information is here.

Ed Witten (IAS, Princeton) will be visiting in January. There will be a workshop "Geometry of Quantum Fields and Strings" on January 10-12. Witten will give a public lecture on Sunday, 12 January at 6 pm at the University of Auckland.

The Michael Erceg Senior Visiting Fellow is Alex Lubotzky (Hebrew University in Jerusalem), who will be visiting during the last week of February and the first week of March.

Chad Higdon-Topaz (Williams College) will be visiting the University of Auckland from Feb 14 to March 3. He will be giving talks/events about equity and diversity in higher education institutions.

The NZMS Forder lecturer Julia Wolf (Bristol) will be visiting in March.

Distinguished Visitor Professor Michael Proctor (Cambridge) will visit from March 9th to April 9th.

Fanny Kassel (IHES) will visit in the last week of April and first week of May.

Other recent visitors include Thomas Leistner (University of Adelaide), Binzhou Xia (University of Melbourne), Srinivasa Rao Subramanya Rao (Edith Cowan University, Perth, Australia), Professor Charles Leedham-Green (QMUL), Valentina Wheeler (University of Wollongong), Professor Evgeny Vdovin (Sobolev Institute, University of Novosibirsk), Jack Borthwick (University of Brest), Francois Thilmany (UCSD), Professor Dane Flannery (National University of Ireland, Galway), Jianhua Zheng (Tsinghua University), Professor Stephen Glasby (University of Western Australia), Dmitry Jakobson (McGill University).

Other news

Josephina Ah Sam has been running the South Auckland Mathematics Challenge. The goal of this competition is to get more students in South Auckland hyped about Mathematics through competition.

John Butcher was a plenary speaker at the conference SciCADE (Scientific Computing and Differential Equations) at the University of Innsbruck in July 2019. He was an invited speaker at the conference GNIDE (Geometric Numerical Integration of Differential Equations) at the Chinese Academy of Sciences, Beijing, in September. He visited the Universities of L'Aquilla and Salerno (Italy) in July, and Kyoto (Japan) in October. He hosted a visit by Dr Helmut Podhaisky of the Martin Luther University, Halle-Wittenberg.

Marston Conder and Gabriel Verret are organising a conference on "Symmetries of Discrete Objects", at Rotorua, the week 10-14 February 2020.

Steven Galbraith gave a plenary talk at the conference Provsec 2019 in Cairns, and a series of lectures at NTT labs in Japan. He has been the program co-chair of Asiacrypt 2019, and will be attending the Asiacrypt conference in Kobe, Japan the week after the NZMS Colloquium.

Bernd Krauskopf (together with Stephane Coen from Physics) has been awarded a Distinguished Visitor Award to host a visit of Stéphane Barland from the Institut de Physique in Nice. His visit is planned for January to April 2020.

Hinke Osinga is hosting the visitor Rafal Bogacz from 3 December 2019 until 31 August 2020. Rafal is Professor of Computational Neurosciences at the University of Oxford. His research interests are in computational models of decision making and control of deep brain stimulation. He wants to learn more about dynamical systems theory with the aim of developing "closed-loop" brain stimulation devices that could help patients with neurological disorders. Hinke is also invited to the Max Planck Institute for Mathematics in the Sciences in Leipzig. She will be one of the main speakers at the symposium "Developments in the Mathematical Sciences" (DIMS 2019) organised by Felix Otto,

Bernd Sturmfels and Jürgen Jost. The event brings together leading experts from a broad range of mathematical fields, with the aim to give insights in recent developments, discuss current trends and gain an overview of today's mathematical landscape.

Malia Puloka is presenting a paper at the 2019 International Association for Statistical Education Satellite Conference IASE Malaysia.

Arkadii Slinko attended the invitation-only Dagstuhl seminar 19381 "Application-Oriented Computational Social Choice" where he gave a talk on Condorcet domains. He continued to work on Condorcet domains with his co-author Professor of Economics Clemens Puppe visiting him in Karlsruhe, and discussed complexity issues related to Condorcet domains with Klas Markstrom in Stockholm. He attended the GameSec conference. Finally is served as a Programme Committe member of the AAAI-20 conference, which will take place in February 2020 in New York.

Tom ter Elst was an invited speaker at the conference "Parabolic evolution equations, harmonic analysis and spectral theory" in Bad Herrenalb, Germany. He participated in the International Workshop on Operator Theory and its Applications, Lisbon. He was an invited speaker at workshop "Analysis and PDE" in Leibniz Universität Hannover. During his sabbatical he visited Professor Wolfgang Arendt and Dr Manfred Sauter (University of Ulm, Germany), Professor Rainer Nagel (Universität Tübingen, Germany), Professor El-Maati Ouhabaz (Université Bordeaux), Dr Joachim Rehberg (Weierstrass Institute for Applied Analysis and Stochastics, Berlin).

Steven Galbraith

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Change is in the air

The University has now adopted the "divisional structure" described in a previous newsletter, and the Department of Mathematics and Statistics is now part of the School of Computing and Mathematical Sciences which is in the Division of Health, Engineering, Computing and Science. Head of this division is Geoff Holmes, our previous dean. Stephen Joe is the acting head of School.

Sean Oughton comes to the end of his term as COD of the department at the end of November, and the role has now been taken by Daniel Delbourgo, email daniel.delbourgo@waikato.ac.nz, telephone 07-838-4425. Rachael Foote, the department administrator has moved to a more senior role in Computer Science and her old position has been advertised.

Figure 1: Dr Jacob Heerikhuisen 2019

To cap it all off the old home of the department TB3, along with all of the temporary University buildings on Hillcrest Road, are being demolished to make way for what is known affectionately by the VC as "The Pa" costing the better part of $100M. Functions of the new building could include offices for the Vice-Chancellor and his staff, an auditorium, food court, and staff club.

Jacob Heerikhuisen

Dr Jacob Heerikhuisen returns to Waikato after spending 16 years in the USA. Jacob earned his PhD from Waikato in 2001 under Dr Ian Craig working on solutions to the MHD equations that describe magnetic reconnection. As a postdoc and then research scientist at UC-Riverside he worked under Dr Gary Zank to develop a Monte-Carlo code that solves the Boltzmann Equation for interstellar hydrogen atoms that wash through the heliosphere, a bubble in space blown into the hydrogen and helium gas that fill the galaxy by the solar wind. Jacob moved with Dr Zank and his group to the University of Alabama in Huntsville in 2009 where he became a faculty member in the Physics and later Space Science departments. He continues to work on simulations of the heliosphere, and collaborates closely with several international groups related to NASA's IBEX (not the goat or Spanish currency!) and future IMAP missions to understand the global structure of the heliosphere through a combination of data and models.

Coming and going

Daniel Delbourgo returned from study leave in France (he attended the Iwasawa Theory conference in Bor-

deaux), Britain (Universities of Notingham and Potadown), Canada (Laval University) and Singapore. Stephen Miller left in June to take up a position with TradeMe in Wellington. Visitors to the department included Alvaro Orsi of CEFCA visiting Woe Chet Lim and Andrea Burgess of the University of New Brunswick visiting Nick Cavenagh. Ian Hawthorn sang with the Hamilton Civic Choir's presentation of Bach's Mass in B minor and Kevin Broughan in Cantando's Christmas concert including Bach's Christmas Oratorio.

Workshop announcement

The 7th NZ Number Theory Workshop will be held at the University of Waikato in March or April next year and all with an interest in number theory or its applications are invited and welcome to present a paper or describe an unsolved problem. To be placed on the mailing list to receive more detailed announcements please contact Daniel at the email address given above.

Kevin Broughan

MASSEY UNIVERSITY

INSTITUTE OF FUNDAMENTAL SCIENCES

At Massey Manawatū, our attention is now on the upcoming NZMS colloquium. It's promising to be a great meeting, we are looking forward to catching up with our colleagues from around the country. In other news:

PhD student Christian Offen has received the 2019 Hatherton Award for his paper "Bifurcation of solutions to Hamiltonian boundary value problems" published in Nonlinearity in 2018. The Hatherton is awarded by the Royal Society Te Apārangi for the best scientific paper by a PhD student at any New Zealand university in chemical, physical, mathematical, and information sciences. In this paper Christian developed the geometric picture of Hamiltonian ODE boundary value problems as the intersection of Lagrangian submanifolds, allowing their bifurcations to be classified by catastrophe theory. Three special cases were considered: (i) specific boundary conditions (e.g. Dirichlet), which restrict the possible types of bifurcations; (ii) integrable systems, which can exhibit a novel "periodic pitchfork" bifurcation; and (iii) systems with symmetries or reversing symmetries, which can exhibit restricted bifurcation types. Christian is presently in Cambridge as a participant in the Newton Institute program "Geometry, Compatibility, and Structure Preservation in Computational Differential Equations."

Robert McLachlan also attended that program during July and August. It was groundhog day as he was back in the same office (F8) he had as a postdoc in 1996. There has been a little scientific progress since then, although some of the open problems from those days are still open. The goal of this program is to foster interactions between groups working in geometric numerical integration and those in finite element exterior calculus. He also made some connections for his sideline in climate change advocacy – he writes on climate change at blog.planetaryecology.org. There was a surprise appearance from Mike Meylan, visiting from the University of Newcastle for a workshop on the Wiener-Hopf technique.

Robert McLachlan has been appointed Editor-in-Chief of the Journal of Computational Dynamics published by AIMS. JCD is focused on the intersection of computation with deterministic and stochastic dynamics. The mission of the journal is to publish papers that explore new computational methods for analyzing dynamic problems or use novel dynamical methods to improve computation. Topics include computation of phase space structures and bifurcations, geometric numerical integration, set-valued numerics, and nonlinear and stochastic model reduction. Bernd Krauskopf and Rua Murray are long-standing editors of this journal. In a time of rapid change in academic publishing, especially the emergence of prolific high-fee open access journals, the model of JCD (open access and no publication fees) is worthy of support.

Richard Brown

SCHOOL OF NATURAL AND COMPUTATIONAL SCIENCES

In August Mick Roberts was the opening plenary speaker at the "7th Symposium on BioMathematics of the Indonesian Biomathematics Society" in Bali. In October he attended the workshop "Borders in Public Health and Mathematical Epidemiology" at The Fields Institute, Toronto, and presented a paper "Ecosystem dynamics and the dilution effect". He then visited Utrecht University to work with Hans Heesterbeek, AI on his Marsden grant.

Shawn Means presented a contributed talk, 'Weaving a Tangled Web: Neurons and Networks', at the 2019 annual meeting for the Society of Mathematical Biology in Montréal, Québec this past July, sharing progress on Carlo Laing's Marsden project. Further, collaborators at York University, Toronto, were visited for extending current model of hepatitis-B viral dynamics, leading to nascent collaboration with immunologists at the Toronto Liver Centre now underway.

In July, Winston Sweatman attended ICIAM in Valencia. He was invited to join a mini-symposium on

"Mathematics for Industry in the Asia Pacific Area" organised by Japanese colleagues within the Asia Pacific Consortium of Mathematics for Industry (APCMfI). He presented a talk to the mini-symposia on MISG in Australia, New Zealand and Japan, and also a poster on celestial mechanics/stellar dynamics. Following on from ICIAM, Winston visited collaborators in Scotland.

Alona Ben-Tal and PhD student, Shumaila Noreen, visited Lancaster University, UK, in July for about a week. They worked with Prof Aneta Stefanovska and her research group. This visit was supported by a Catalyst Seeding Grant. From the UK they travelled to Valencia, Spain, to participate in the International Congress on Industrial and Applied Mathematics (ICIAM 2019). The congress was opened by the King of Spain who gave an impressive speech and later mingled with the audience during morning tea. Shumaila presented a poster entitled "Mathematical Modelling of the Cardiovascular System to Study the Effects of Respiratory Sinus Arrhythmia on Cardiac Output". Alona chaired a minisymposium she organized entitled "Oscillators in living systems" and presented a talk entitled "Oscillations in the brainstem: modelling neural control of breathing".

Alona was an invited speaker at the MedSci 2019 conference in Queenstown, 2-4 September. Her talk entitled "New approach for modelling the cardio-respiratory system" was part of a symposium entitled "New concepts and emerging therapies for cardiac dysfunction" which she also co-chaired.

Alexander Melnikov has been awarded a Rutherford Discovery Fellowship for research titled "Applications of modern computability".

Graeme Wake was recently an invited witness (of just three contributors) to the Government-sponsored review in October of the scientific procedures used in NZ's Resource Consent Allocation processes and procedures. This was hosted by the Ministry for the Environment. He has been involved as an expert witness in recent legal cases. This evidence has now been made public and is to be a subject of his seminar at the November Mathematical Sciences Symposium at Auckland University of Technology. Graeme is also continuing in December to be on the judging panel for the Prime Minister's Science Teacher's Prize, where there is stiff competition this year for this valuable prize.

Carlo Laing attended the Sydney Dynamics Group meeting in Margaret River, Western Australia, November 4-8.

Carlo Laing

VICTORIA UNIVERSITY OF WELLINGTON

SCHOOL OF MATHEMATICS AND STATISTICS

We are sad to say goodbye to our colleague Adam Day, who is leaving to take up a position with the Tertiary Education Commission. Adam obtained his PhD from VUW in 2011 and then won a prestigous Miller Fellowship at the University of California at Berkeley from 2011-2013. In 2013, Adam joined VUW as a Lecturer. The School thanks Adam for his significant contributions, including contributions to the School's outreach and equity activities, and to the School's Learning and Teaching Committee.

PhD candidate Jasmine Hall was selected as the 2019 Bevan Werry speaker at a Conference of the New Zealand Association of Maths Teachers (NZAMT). The Bevan Werry award is inspired by Bevan Werry, a mathematician and educator who spent his life developing the mathematics curriculum in New Zealand, making recommendations to UNESCO, contributing to Mathematical Digest and other publications.

Jasmine spoke about the National Certificate of Educational Achievement (NCEA) mathematics curriculum and the need for it to change. The talk covered Jasmine's upbringing with her mathematician father, a passion for "Murderous Maths" books and Escher's tessellations, and how this lead to her current PhD research in Graph Theory, Image Recognition and Tangles. She highlighted the challenges of the NCEA curriculum: limited applicability, idolising calculus over the wide range of mathematics and the absurdly framed problems to name a few issues. The talk culminated in her recommendations for the future: a compulsory logic-based curriculum and an optional curriculum focused on each students interests and strengths.

The School has had a number of grant successes recently. Ivy Liu, Binh Nguyen and Richard Arnold, together with colleagues from the School of Engineering and Computer Science, have been acknowledged by the Minister of Science, Research & Innovation with the award of major new funding for a significant new project. They have received $13m of funding over the next 7 years to work on a project for data-science driven evolution of aquaculture. They will be working with a team that includes collaborators from the University of Otago, the Cawthron Institute, and a few other companies.

Matt Visser has received a Marsden grant titled "Black holes beyond relativity". Nick Brettell has been awarded a Rutherford Foundation postdoctoral fellowship for research titled "Matroids representable over all fields of size at least four"; he will be joining VUW to work with Geoff Whittle.

The International Conference on Probability Theory and Statistics, held in Georgia in September, was dedicated to the 75th birthday of our colleague Estate Khmaladze. The 7th Wellington Workshop in Probability and Mathematical Statistics, to be held at VUW on December 5-7, will also celebrate Estate's birthday. Estate has been a driving force behind this series of Wellington Workshops that started in 2009.

We are also hosting a Teacher Symposium on December 13; the topic is inquiry-based learning in mathematics and statistics. The third conference hosted by our School this December is the 10th Australasian Conference on General Relativity and Gravitation, organised by Matt Visser and Sebastian Schuster.

Peter Donelan is currently a visiting fellow of the Institute of Advanced Studies at the University of Bologna. He is a guest of Marco Carricato in the Department of Industrial Engineering. He gave a seminar to the Institute on mathematics and poetry, focusing on the Romanian geometer and symbolist poet Dan Barbilian. He has also given a research seminar in the Mathematics Department on robotics and invariant theory, and a talk to the postgraduate students on singularity theory and applications in robotics.

Our colleague Martino Lupini was promoted to Senior Lecturer. Congratulations, Martino!

Astrid an Huef

UNIVERSITY OF CANTERBURY

SCHOOL OF MATHEMATICS AND STATISTICS

Congratulations to *Jeanette McLeod* and *Phil Wilson* for being awarded the 2019 New Zealand Association of Scientists (NZAS) Cranwell Medal for Science Communication. This award recognises their great work with Maths Craft and their unique contribution to New Zealand's public science scene. Since co-founding Maths Craft NZ, a non-profit initiative, in 2016 Jeanette and Phil and the team of Maths Craft have brought maths to the masses. More than 11,000 people from a diverse variety of backgrounds have now attended the regular free Maths Craft festivals and workshops, making it the largest maths outreach programme in New Zealand. Maths Craft has been supported by Te Pũnaha Matatini since its inception.

Jeanette and Phil have written dozens of freely-available instructional handouts to be distributed at Maths Craft events. Furthermore, they have trained and mentored many volunteers and team members, trained teachers, given public talks, and collaborated with other researchers to determine the efficacy of their approach.

Jeanette, Phil, and the Maths Craft team have just taken part in the inaugural STEMFest in Tauranga,

Jeanette McLeod and Phil Wilson

proudly putting the M in STEM as the only maths outreach exhibitor at the festival. STEMFest is the creation of Tia Lush, and is "a world class festival, designed to engage and inspire a new generation of scientists, technologists, engineers and mathematicians." Almost 5,000 tickets to the day-long event on 12 October were given away, with Maths Craft bringing their unique approach to mathematics outreach to almost 1,500 people.

Congratulations to *Varvara Vetrova* who is part of the team that has been awarded a grant from the MBIE strategic investment in Data Science. Their work is a collaboration between Waikato, Canterbury, Auckland Universities, MetService, and Beca. The project is Time-Evolving Data Science / Artificial Intelligence for Advanced Open Environmental Science, and is focussed on developing new methods to deal with environmental datasets that are collected in large volumes over time, ranging from broad scale satellite images to single point measurements on the ground, in the water or air.

In August the School welcomed *Thomas Li* who has been appointed to a continuing lecturer position. Thomas already was in the School on a 2-year fixed term contract.

At the beginning of August *Jeremy Booher* has joined the school as a postdoc (2 years), funded by Felipe Voloch's Marsden grant. Jeremy got his PhD at Stanford University in 2016 and was a postdoc at the University of Arizona before coming to UC. His research interests are in algebraic number theory and arithmetic geometry, especially Galois representations and coverings of curves in positive characteristic.

Also in August *Jennifer Wilcock* has started as a lecturer in statistics on a fixed-term contract. She arrives from Massey University in Palmerston North where she was a post- doctoral fellow working with Martin Hazelton on statistical inverse problems relating to modelling traffic flows on road networks. Earlier, she was awarded her PhD in 2018 by the University of Auckland where she worked with Alan Lee on semiparametric inference for complex case-control designs. She continues to work in both these research areas, and in addition as a methodologist with applied researchers in the political and policy sciences.

Jeremy Booher and Jennifer Wilcock

At the end of August the NZ Number Theory Workshop 2019 was held at the School. The one-day event featured four talks and a problem session. The workshop was organised by *Brendan Creutz* and *Felipe Voloch*.

In July Matthew Simpson from Queensland University of Technology visited the School for three months as part of the university's unique Erskine programme. Mat has a long history of working with *Mike Plank* and others in the School so knew to bring his own bike with him. Mat's research fields are in numerical and computational Mathematics and, in particular, works in mathematical biology. He has even been known to conduct his own experiments occasionally! Mat was hosted by *Alex James*, and whilst here, worked with Mike Plank, Rachelle Binny (Manaaki Whenua), Alex James and Oliver McLaren (Auckland). He also got to share in the fun of 100 level teaching, teaching into our entry course MATH102 (Mathematics 1A), covering single variable calculus and basic ideas in linear algebra.

In September, in time for term 4, the School welcomed three further Erskine Fellows, each of whom visited the School for five to six weeks. John Hinde, hosted by *Carl Scarrott*, comes from the National University of Ireland in Galway, Ireland, is past President of the International Biometrics Society and one of the founding editors of the journal Statistical Modelling. During his visit he taught on a module of STAT213 (Statistical Inference) and presented seminars on Count Data Regression Models: Properties, Applications and Extensions at the Victoria University of Wellington, University of Otago, and University of Canterbury at Christchurch. John's research interests are in methodology, computation and application of statistical modelling. He had interesting discussions on aspects of count data modelling with staff in both Wellington and Dunedin and also engaged with the UC statistics group renewing potential research collaborations with Carl.

Michel Lavrauw, from Sabancı university in Istanbul, Turkey, taught into MATH324 (Coding theory and Cryptography), which is closely aligned with his own research interests: finite fields, finite geometry and coding theory. Michel was hosted by *Geertrui Van de Voorde*.

Regina Burachik is from the University of South Australia. She was accompanied by Yalcin Kaya, also from the University of South Australia. Both were hosted by *Chris Price*. Regina's areas of speciality are non-smooth and multi objective optimisation, convex analysis, and monotone operators. She taught into MATH303 (Applied Matrix Algebra). Yalcin's specializes in various aspects of optimal control, including multi objective control, duality, and optimal path planning.

Former staff member *Douglas Bridges* was an invited speaker at the Mathematical Logic and Constructivity meeting at Stockholm University in August, and spent one month working with Erik Palmgren in the Matematiska Institutionen there.

Günter Steinke

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Warmest congratulations to **Tilman Davies** and his wife Andrea on the birth of their daughter Quinn Ulrike Joan, born 26 July. All the best to the young parents.

Tilman and Quinn

We welcomed **Martin Hazelton**, who has taken up his position as Professor of Statistics at the Department. After completion of his doctoral studies at the University of Oxford, Martin held positions at Oxford, University College London, the University of Western Australia, and, most recently, as the Chair of Statistics and

Head of Institute of Fundamental Sciences at Massey University. His research interests in theoretical and applied statistics include linear inverse problems and polytope sampling, nonparametric smoothing, and spatial statistics.

Welcome, Martin Hazelton

The Department celebrated multiple grant successes. Congratulation to **Fabien Montiel** for his involvement in a successful MBIE Smart-Ideas grant, and to the Marsden recipients **Tim Candy**, **Tilman Davies** and **Martin Hazelton**, **Jörg Frauendiener**, and **Phillip Wilcox**.

- Fabien is part of a multi-disciplinary team of international researchers that secured MBIE funding for their project "Better sea ice predictions for shipping via wave-ice forecasting". The goal is to develop a 6-day forecast system for sea ice conditions in conjunction with waves, winds and currents, allowing safer navigation in the ice-covered Southern Ocean.

- In his Marsden fast-start project, Tim will study the "Global behaviour of nonlinear dispersive partial differential equations". He will address this problem for important model equations in mathematical physics by developing new multilinear restriction estimates, which are closely related to the unsolved restriction conjecture in harmonic analysis.

- Tilman (PI) and Martin (AI) received their Marsden grant for the project "A new generation of statistical models for spatial point process data". They intend to disentangle two fundamental components of spatial models, one relating to persistent spatial (fixed) effects and the other reflecting (stochastic) interactions between points, such as a tendency to cluster together. This has applications in fields as diverse as epidemiology, ecology, and archaeology.

- The goal of Jörg's Marsden project "Gravitational waves from rotating black holes" is a systematic study of the interaction of gravitational waves and black holes, in particular, over long time and distance scales.

- Finally, Phil is an AI on the Marsden project "Walking backwards into the future: An evolutionary investigation into the high rates of metabolic disease in Pacific populations", which will study why Māori and Pasifika populations are disproportionately affected by metabolic diseases such as diabetes, gout, obesity, renal and heart disease.

Jörg Hennig

PhD SUCCESS

Yan Bo Ti (University of Auckland)

Title: Isogenies of Abelian Varieties in Cryptography

Supervisors: Steven Galbraith

Abstract: Isogenies of abelian varieties have been used in cryptography to create post-quantum cryptosystems. In particular, supersingular elliptic curve isogenies have been used to construct key exchange, encryption and signature protocols and hash functions. This thesis concerns itself with results relating to this cryptosystem and presents four main findings: two attacks, a reduction and a generalisation.

The two attacks on the cryptosystem are an adaptive attack and a fault attack. The adaptive attack targets instances of the cryptosystem using static keys and is able to recover the secret with close to optimal number of queries for most use cases. The fault attack targets the cryptosystem embedded in hardware and is able to recover the entire secret with one successful perturbation.

The reduction shows that breaking the cryptosystem is at most as difficult as computing endomorphism rings of supersingular elliptic curves. It relies on the equivalence of the category of supersingular= elliptic curves under isogenies and the category of invertible modules under homomorphisms.

We also generalise the cryptosystem from isogenies between supersingular elliptic curves to isogenies between supersingular principally polarised abelian surfaces. In particular, we propose a genus two version of the key exchange protocol called Genus Two SIDH (G2SIDH). We perform some analysis of the security of G2SIDH by studying the isogeny graph of principally polarised abelian surfaces. A by-product of this study is that a naive generalisation of the hash function to genus two is no longer collision resistant.

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Keegan Flood (University of Auckland)

Title: The geometry of solutions to the metrizability equation in projective and c-projective geometry.

Supervisors: Rod Gover, Pedram Hekmati

Abstract: On a smooth manifold, a pseudo-Riemannian metric whose Levi-Civita connection lies in the projective class of a given torsion-free affine connection is equivalent to a maximal rank solution of an overdetermined projectively invariant differential equation termed the metrizability equation. Similarly, a pseudo-quasi-Kähler metric whose compatible connection is in the c-projective class of a given minimal complex affine connection on an almost complex manifold is equivalent to the maximal rank solution of an overdetermined c-projectively invariant differential equation also known as the metrizability equation. We replace rank assumptions on solutions to these equations with more general conditions on their prolonged systems. We show that the underlying manifolds are stratified according to the strict signature of the solutions in a manner that generalizes the stratification of a model, namely an orbit decomposition of the projective sphere or complex projective space. Whence the solutions give curved generalizations of such orbit decompositions. We determine the geometries on each of the strata; in particular, a metric on the open strata that degenerates on the closed boundary strata, where the boundary strata can be viewed as the projective or c-projective infinity for the given metric. In doing so, we provide new results for the projective compactification of scalar-flat metrics and c-projective compactification of Kähler metrics with non-vanishing scalar curvature. The results also show that Cartan holonomy reductions arising from normal BGG solutions to the projective and c-projective metrizability equations extend to more general Cartan structure group reductions for suitable non-normal solutions.

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Gareth Gordon (University of Auckland)

Title: Dirichlet-to-Neumann graphs on partial boundaries

Supervisors: Tom ter Elst, Jari Kaipio

Abstract: This thesis considers how one can construct a Dirichlet-to-Neumann operator on a sufficiently regular subset $\mathscr{C}$ of the boundary of a bounded Lipschitz domain Ω. We consider two methods of construction. First by placing a Dirichlet condition on the complement of $\mathscr{C}$. Second by placing a Neumann condition on the complement

of $\mathscr{C}$. After constructing these operators we prove basic properties as well as Kreĭn-type resolvent formulae. We also define their $L_2(\mathscr{C})$ realisations using form methods.

Next we prove several convergence theorems for these Dirichlet-to-Neumann operators. We focus on two situations. We either fix the domain Ω and consider a sequence of subsets $(\mathscr{C}_n)_{n\in\mathbb{N}}$ of $\partial\Omega$ or we fix the partial boundary $\mathscr{C}$ and consider a sequence of bounded Lipschitz domains $(\Omega_n)_{n\in\mathbb{N}}$ such that $\mathscr{C} \subseteq \partial\Omega_n$ for all $n \in \mathbb{N}$. Types of convergence proved include operator convergence, resolvent convergence and semigroup convergence.

Finally we consider the situation where Ω is a Lipschitz hypograph. We define a Dirichlet- to-Neumann operator on the Lipschitz graph $\partial\Omega$. Then we approximate Ω by a sequence of truncations of Ω and prove convergence theorems such as resolvent convergence of Dirichlet- to-Neumann operators on the truncated Ω to the Dirichlet-to-Neumann operator on Ω.

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Susan Jowett (Victoria University of Wellington)

Title: Unavoidable Minors of Large 4-connected Binary Matroids

Supervisors: Geoff Whittle

Abstract: Abstract: In two famous papers in matroid theory, Ding, Oporowski, Oxley and Vertigan described fully the unavoidable minors of 3-connected matroids. The first paper considers the binary case. This thesis is concerned with the analogous problem for 4-connected binary matroids. It follows from the work of Ding et. al. and the fact that 4-connected matroids are also 3-connected, that a sufficiently large 4-connected binary matroid has a large M(K3,n), M?(K3,n), M(Wn), or binary spike as a minor. We begin with such minors and describe the outcomes when all 3-separations of the minors are bridged in the original matroid. We give a solution for the first two cases and describe the unavoidable 4-connected minors that arise in this situation when we do not have $M^*K_{3,n}$ blocked in a path-like way. The M(Wn) case proved to be much more challenging than expected meaning that it was not possible to complete the spike case in time for inclusion in this thesis. A clear strategy exists for this case and it is planned to complete it in future research.

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Jessica Santiago (Victoria University of Wellington)

Title: On the Connections Between Thermodynamics and General Relativity

Supervisors: Matt Visser

Abstract: We live in a curved space-time. You may call it gravity, you may call it curvature. Anything, any matter, any particle with mass or momentum will feel it. Gravity behaves very differently from the other forces because it is not a force. It is a property of the universe. On the other hand, we have matter. There are particles and quantum fields. These particles and fields interact with each other, they agglomerate. They exist and, as long as they exist in groups, it is possible to describe them thermodynamically. Jessica's research concerns what happens when the theories describing these two scenarios meet and what we can obtain from the connections between thermodynamics and general relativity.

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Seyedvahid Amirinezhad (Victoria University of Wellington)

Title: A Constraint-Based Approach to Manipulator Kinematics and Singularities

Supervisors: Peter Donelan, Matt Visser

Abstract: In this thesis, a differential-geometric approach to the kinematics of multibody mechanisms is introduced that enables analysis of singularities of both serial and parallel manipulators in a flexible and complete way. Existing approaches such as those of Gosselin and Angeles [1], Zlatanov et al. [2] and Park and Kim [3] make use of a combination of joint freedoms and constraints and so build in assumptions. In contrast, this new approach is solely constraint-based, avoiding some of the shortcomings of these earlier theories. The proposed representation has two core ingredients. First, it avoids direct reference to the choice of inputs and their associated joint freedoms and instead focuses on a kinematic constraint map (KCM), defined by the constraints imposed by all joints and not requiring consideration of closure conditions arising from closed loops in the design. The KCM is expressed

in terms of pose (i.e. position and orientation) variables, which are the coordinates of all the manipulator's links with respect to a reference frame. The kinematics of a given manipulator can be described by means of this representation, locally and globally. Also, for a family of manipulators defined by a specific architecture, the KCM will tell us how the choice of design parameters (e.g. link lengths) affects these kinematic properties within the family. At a global level, the KCM determines a subset in the space of all pose variables, known as the configuration space (C-space) of the manipulator, whose topology may vary across the set of design parameters. The Jacobian (matrix of first-order partial derivatives) of the KCM may become singular at some specific choices of pose variables. These conditions express a subset called the singular set of the C-space. It is shown that if a family of manipulators, parametrised by a manifold Rd of design parameters, is "well-behaved" then the pose variables can be eliminated from the KCM equations together with the conditions for singularities, to give conditions in terms of design parameters, that define a hypersurface in Rd of manipulators in the class that exhibit C-space singularities. These are referred to as Grashof-type conditions, as they generalise classically known inequalities classifying planar 4-bar mechanisms due to Grashof [4]. Secondly, we develop the theory to incorporate actuator space (A-space) and workspace (W-space), based on a choice of actuated joints or inputs and on the manipulator?s end-effector workspace or outputs. This will facilitate us with a framework for analysing singularities for forward and inverse kinematics via input and output mappings defined on the manipulator's C-space. This provides new insight into the structure of the forward and inverse kinematics, especially for parallel manipulators.

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Jack R. Simpson (University of Canterbury)

Title: Tree structure in phylogenetic networks

Supervisors: Charles Semple, Mike Steel

Abstract: Phylogenetic trees are widely used to express and explore evolutionary relationships. In recent times, the observation of evolutionary processes that cannot be expressed by individual phylogenetic trees has prompted interest in the study of phylogenetic networks. Phylogenetic networks generalise phylogenetic trees by allowing non-treelike events to be represented. A particular consequence of this is that a phylogenetic network may be understood to simultaneously express the relationships of a number of different phylogenetic trees. These phylogenetic trees are then said to be embedded in the network.

In this thesis, the connections between various classes of phylogenetic networks and their corresponding sets of embedded phylogenetic trees are explored. Among others, the following questions are expanded on and answered.

1. For a given set of trees does there exist a network that embeds each tree? In the case of level-1 networks a polynomial time algorithm is given that outputs, up-to a particular topological ambiguity, the unique level-1 network with minimum reticulations that displays a given set of trees or identifies that no such network exists.

2. From a given set of trees embedded in a network can the network be reconstructed? It is proven that a normal network can be reconstructed from a subset of the trees it displays that grows linearly with respect to the number of leaves in the network.

3. For a given network how many embedded trees are required to use every vertex and every edge of the network? It is proven that the class of stack-free network is precisely the class of networks for which only two embedded trees are required to use every vertex and every edge of the network.

4. For a given network and tree does the network embed the tree? In the case of sibling-free networks a polynomial time algorithm is given that outputs, for a given network and tree, whether or not the network embeds the tree.

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Amina Shahzadi (University of Otago)

Title: Hidden Markov Models for time-inhomogeneous and incompletely observed point processes

Supervisors: Ting Wang, Matthew Parry, Mark Bebbington

Abstract: Many point processes such as earthquakes or volcanic eruptions usually have incomplete records with

the degree of incompleteness varying over time. Consequently, hazard estimation from such time-inhomogeneous incomplete records is complicated and potentially biased. Since the number of missing events is unknown, two distinct HMM-type methodologies are proposed: one with the observed process having a fixed number of missing events between each pair of consecutively observed events, and the other with the observed process having a variable number of missing events between each pair of consecutively observed events in an incomplete point process record.

In the first approach, a general class of inhomogeneous hidden semi-Markov models (IHSMMs) is proposed for modelling incompletely observed point processes when incompleteness does not necessarily behave in a stationary and memoryless manner. The key feature of the proposed model is that the sojourn times of the hidden states in the semi-Markov chain depend on time, making it an inhomogeneous semi-Markov chain. We check a conjecture of consistency of the parameter estimators of the proposed model by simulation study using direct numerical optimization of the log-likelihood function. We apply this class of models to a global volcanic eruption catalogue to investigate the time-dependent incompleteness of the record by proposing a particular IHSMM with time-dependent shifted Poisson distributed state durations and a renewal process as the observed process with a fixed number of missing events between each pair of consecutively observed events in the record. A combination of the Akaike Information Criterion and residual analysis is used to choose the best model. The selected inhomogeneous hidden semi-Markov model provides useful insights into the completeness of a global record of volcanic eruptions during the last 2000 years, demonstrating the effectiveness of this method.

In the second approach, shifted compound Poisson-gamma (SCPG) and time-dependent SCPG (TSCPG) renewal processes are introduced in order to model the unknown and time-dependent random variable number of missing events between each pair of consecutively observed events in incompletely observed point processes. The SCPG renewal process models the shifted Poisson distributed number of missing events, and the TSCPG renewal process models the time-dependent shifted Poisson distributed number of missing events between each pair of consecutively observed events in the gamma renewal process. In addition to IHSMMs and SCPG renewal processes, a special case of inhomogeneous hidden Markov models (IHMMs) is developed to examine nonstationary incompleteness of point processes. The multinomial logistic functions are adopted to formulate the time-varying transition probabilities in the proposed IHMM in the way that characterizes the temporal structure of the missingness of events in records. The SCPG and TSCPG renewal processes are used as the observed processes in HMMs, HSMMs, IHMMs and IHSMMs to model the time-dependent incomplete point process records. Simulation experiments are employed to check the performance of proposed renewal processes with different types of HMMs. We apply these models to a global volcanic eruption record during the last 10000 years to analyze and demonstrate how we estimate the completeness of the record and the future hazard rate. All proposed models can be utilized to model other types of inhomogeneous processes with or without missing data.

OBITUARIES

Wayne Walker, 02/06/1944- 06/09/2019

Wayne Walker

Wayne and I came to the mathematics department at about the same time and for decades we had an office next door to one another. Early on, I went to a lecture he gave derived from the work he had done in his PhD thesis and remember thinking at the time that this is a really clever guy. But his work was in a somewhat different field from mine so for the next 10 years he did his thing and I did mine.
All that changed in 1981 when we both attended a lecture by former staff member Chao Chang. Chao had done something particularly interesting and we both latched onto it. After much discussion we wrote our first paper together, with the very cool title: Finite Harmonic Interpolation. After that we were constantly in and out of each other's office. My blackboard was covered with his calculations and his blackboard with mine. Wayne was just such a pleasure to work with and we never had an argument in the many years we worked together.

In working together, we often called each other after working hours and generally their daughter Amelia would answer the phone when I called. I would put on my best Kiwi accent and just say "gidday", just one word in an attempt to fool her, but her response was always, "Dad, Joel's on the phone". Two more papers followed on the same topic of Finite Harmonic Interpolation.

But a few years later we stuck pay dirt. Based on some work at the turn of the 20th century that Wayne had dug up, we discovered what is known as a sampling formula. To give you the general flavor of what that means, let me pose the question of how do you put Beethoven's Fifth Symphony on a compact disk? The answer is to take a sample of the music many times per second, and convert the recorded sound at each instant into a numerical format. But as you are only picking up the sound at just discrete intervals, this would leave little gaps in the sound when you decoded it. That is where a sampling formula comes in and there are several different ones, depending on the application. The mathematics of a sampling formula fills in the gaps and reconstructs the original sound signal completely as if by magic. This is essentially how your TV, cellphone, and all modern digital communications work.

Our sampling formula looked beautiful on paper, but did it actually work and were the rather dense calculations correct? With my feeble computing skills, I wrote a basic program to see if we would get anything useful out of it. It turned out to be accurate to 6 decimal places even using it in its crudest form. When I showed Wayne the computer results the thrill was as if we had discovered electricity. The sampling formula became known as the Arithmetic Fourier Transform and led to many developments over a period of about 10 years. We were told at one stage by some researchers in California that it had been implemented on a computer chip. Subsequently, we both got diverted into doing other things and never got around to writing the book we had intended to on our beautiful new sampling theorem.

Following this period, I remember that Wayne was involved with various people from the Medical School who would visit his office regularly. The spread of infectious diseases, like measles, is modelled with what are called differential equations, and Wayne was an expert in this field. Not only diseases but a well-known brain researcher, Sir Richard Faull, would also visit, such was Wayne's expertise in a wide range of fields. One of Faull's findings is that mental and physical stimulation creates new brain cells, even in old age. This can only be good news for all of us!

Wayne was not only an outstanding researcher but he was also a very fine and conscientious lecturer. I would often hear through the walls of our offices how patiently and carefully Wayne explained material to students. Many times, I felt like I would have throttled the student under similar circumstances. His outstanding lecturing style is attested to in the many tributes from former students. One such was a brilliant student named Sean Cooper, now teaching at Massey University, who had this to say:

He was revered by my classmates for his lecturing style: the big round handwriting that could be read from anywhere in the room, the clear voice, sometimes with a touch of humour, the wonderful logical development of any topic he taught, and best of all his friendly and approachable manner. Although my notes from those courses are long gone, whenever I am teaching one of those topics I think back to how Wayne did it in his lectures and do my best to copy his style.

Another brilliant student that Wayne taught and guided was Hamish Spencer, now at Otago University, who has stated that Wayne was one of the most inspiring lecturers he had, possibly THE most inspiring. When Hamish was torn between doing mathematics or zoology, he turned to Wayne for guidance.

So I went to see Wayne who made time for me in his unassuming selfless way. Together we plotted out a more mathematically oriented degree that nevertheless contained some biology, a plan that I followed. Then when it came to my honours year, Wayne put together a special biological mathematics reading paper just for me. The following year I moved back to zoology, but did a mathematical project for my thesis, something I also did when I went on to my PhD at Harvard. In brief, that conversation with Wayne changed my life, and I am grateful for it still.

And speaking of brilliant students, Gaven Martin, relates that Wayne was the first staff member he met at the university and who convinced him to do the accelerated maths courses. That single act ultimately led to Gaven becoming one of the finest mathematicians this country has ever produced. Indeed, the Mathematics Department has been blessed with its share of brilliant students and Wayne played a key role in steering many of them into very successful future careers.

I should further add that Wayne also performed various administrative tasks that I tried to avoid at all costs. In a large group of diverse individuals such as the Mathematics Department, there are bound to be a number of hiccups in its smooth running and dare I say it, personality clashes. Former head of department, David Gauld, relates that he could always rely on Wayne to fix up messes created by others.

So, it is goodbye dear friend, we experienced the highs and lows of doing mathematics together, and I could not have asked for a better partner. When I told my son Aaron that Wayne had passed away, his words were,"he was a kind and gentle person." Yes, he was certainly that too. Wayne Walker died on 6 September, 2019, age 75. He will be greatly missed by all who knew him.

Joel Schiff

REPORTS ON EVENTS

International Conference on Mathematical and Numerical Aspects of Wave Propagation (WAVES 2019)

In August 2019, I attended the 14th International Conference on Mathematical and Numerical Aspects of Wave Propagation (WAVES'2019) in Vienna, Austria. This was the first international conference I have taken part since my return from maternity leave in 2018. Therefore, it was a great opportunity for me to be able to present my work there and reconnect with the community after my absence. Being the mother of a 21 month-old toddler, a condition for my participation was to be able to bring my son with me. This has been possible thanks to the generosity of the NZMS, who provided me with financial support for family responsibilities.

My current research is on the mathematical and numerical aspect of wave phenomena and related inverse problems. At the conference, I presented two recently published papers from collaborations with overseas researchers. The first presentation was about seismic imaging and challenges in building extended image volumes to canvas the Earth's Interior. The second paper was on a three-step strategy to solve inverse scattering problems when the source is unknown, while the knowledge of the latter is essential to perform imaging via optimisation techniques. Both talks have been very well received by the audience.

My participation at this conference was the opportunity to represent New Zealand (and actually Oceania), allowing all five continents to be represented as mentioned in the first day at the opening. As outcomes of the conference, I have been invited to speak and take part to two events: a mini-symposium "Computational methods for inverse wave problem" (part of the 14th World Congress on Computational Mechanics (WCCM XIV) and the 8th European Congress on Computational Methods in Applied Science and Engineering (ECCOMAS 2020)), in July 19-24, 2020 in Paris, France, and a workshop on Women in Inverse Problems to be held in Banff, Canada.

Marie Graff (University of Auckland)

Equadiff 2019

I would like to thank the NZMS for providing me with a Caregiver Support grant to participate in the conference *Equadiff 2019* that was held at Leiden University, Netherlands, on 8–12 July. At this conference I gave the talk *Generalized Mandelbrot and Julia sets in a family of planar angle-doubling maps* and I presented the poster *Existence of Blenders in a Hénon-Like Family: Geometric Insights from Invariant Manifold Computations*. Thanks to the NZMS grant, I was able to take my daughters (1.5 and 3.5 years old at the time) and my husband as their carer with me to the conference.

In my talk I presented a perturbation of the complex quadratic family that maintains the property of angle-doubling but that replaces the critical value by a critical circle. I showed how we employ advanced numerical techniques to compute the invariant sets of the map and their interactions with the (generalised) Julia set, which are encoded in parameter space by a generalised version of the Mandelbrot set with a "fat boundary". The topic of my poster was a complicated type of invariant object called a blender, which is so "dense" that it acts geometrically as a set of higher dimension. I presented how blenders appear in a three-dimensional Hénon-like map by computing the associated invariant manifolds, thus generating the first images of a blender in an explicitly given system.

Participating in the Equadiff 2019 was an excellent opportunity for me to take my results on generalised Mandelbrot sets and the geometry of blenders to the experts in dynamical systems. In particular, I discussed with them our work in progress on blender-like chaotic attractors, I was able to find new examples of systems that arise in applications and that may exhibit blenders, and I explored future research questions and opportunities beyond my current postdoctoral position.

Stefanie Hittmeyer (University of Auckland)

NZAMT 2019

NZ Association of Maths Teachers (NZAMT) holds a conference every two years in locations around NZ. Their 16th conference with the theme "Embracing Ako: Game On" was held October 1–4 in Lower Hutt and organised

mostly by the Wellington Mathematics Association including Dillon Mayhew, VUW. This conference brings together primary and secondary teachers of mathematics and statistics as well as maths education researchers and university mathematicians. It is a great opportunity to hold conversations across these sectors. A full report appears in our Education column in this Newsletter. I was able to attend and present at this conference thanks to the help of a grant from NZMS.

Cami Sawyer (Massey University)

GENERAL NOTICES

An article about the "May 12 initiative" from the Notices of the American Mathematical Society

The idea of celebrating women in mathematics on Maryam Mirzakhani's birthday, May 12, was proposed by the Women's Committee of the Iranian Mathematical Society at the World Meeting for Women in Mathematics in 2018. The "May 12 Initiative" rose to a global and inclusive call to action, uniting several national and continental women-in-mathematics organizations worldwide. More information in the notices of the AMS.

Astrid an Huef

Call for applications for the 2020 Zonta Science Award

The 2020 Zonta Science Award is a post-doctoral Award for New Zealand women scientists. The Award is aimed at an emerging scientist rather than someone well-established in their career and preference is given to a woman within seven years of obtaining her PhD, working or studying within the STEM fields (science, technology, engineering, mathematics). The winner receives $15,000 cash, $3,000 towards overseas travel and a commemorative medal.

Further information and online application forms are available here or by writing to award@zontascience.org.nz. Applications close on Monday 3rd February 2020

Astrid an Huef

CWM Call

The Committee for Women in Mathematics of the International Mathematical Union invites proposals for funding of up to €3000 for activities or initiatives taking place in 2020, with deadline 15 January, 2020. More information here. The CWM also maintains a webpage for funding opportunities that relate particularly to women.

Astrid an Huef

News from the 2019 annual meeting AustMS

The program includes a plenary talk "Advancing women in Australian Mathematics: context, challenges and achievements" by Joanna Sikora from the Australian National University. From the abstract: "This talk reviews recent research undertaken by social scientists on women in mathematics."

There is also a Special Session titled "Inclusivity, diversity, and equity in mathematics".

Astrid an Huef

Conference on "Symmetries of Discrete Objects", Rotorua, 10–14 February 2020

A third conference on "Symmetries of Discrete Objects" will be held in February 2020, this time in Rotorua. (The first two were in Queenstown in 2012 and 2016.) The conference theme is broad, and includes symmetries of graphs, maps, polytopes, Riemann/Klein surfaces, and other discrete structures such as block designs and finite geometries, with theory and applications of groups as a common thread.

So far, the confirmed invited keynote speakers include

- Anneleen De Schepper (Ghent University, Belgium)
- Dimitri Leemans (Université Libre de Bruxelles, Belgium)

- Joy Morris (University of Lethbridge, Canada)
- Primož Potočnik (University of Ljubljana, Slovenia)
- Jozef Širáň (Open University, UK, and Slovak University of Technology, Slovakia).

For more details, see the website.

If you are interested in attending, please register as soon as possible. (Registration fees do not have to be paid until 4th January 2020, but we need to have a good idea of participant numbers well before then.)

Marston Conder and Gabriel Verret (Conference organisers)

Conference on Geometry of Quantum Fields and Strings, University of Auckland, 9–12 January 2020

We are pleased to announce the conference Geometry of Quantum Fields and Strings at the University of Auckland, with the following distinguished speakers:

- Mina Aganagic (University of California, Berkeley)
- Stavros Garoufalidis (Georgia Institute of Technology)
- Michael Freedman (Microsoft Station Q)
- Rafe Mazzeo (Stanford University)
- Eckhard Meinrenken (University of Toronto)
- Clifford Taubes (Harvard University)
- Mathai Varghese (University of Adelaide)
- Edward Witten (Institute for Advanced Study, Princeton)

The dates for the meeting are Friday 10 January, 2020 until Sunday 12 January, 2020, and it will be focused on recent advances and applications of the theory of quantum fields and strings in pure mathematics.

Edward Witten and Michael Freedman will give departmental seminars on Thursday 9 January, from 2-4.30pm:

http://pedram.hekmati.se/Auckland2020/Seminars.pdf

Edward Witten will deliver the Hood Public Lecture on "New Observations of Black Holes" on Sunday 12 January at 6pm:

http://pedram.hekmati.se/Auckland2020/PublicLecture.pdf

The registration deadline is Tuesday, 10 December, 2019. Please register and book accommodation early as it is peak season in Auckland.

For further information, including registration, programme, transport and accommodation, see the conference website:

http://pedram.hekmati.se/Auckland2020

Pedram Hekmati (University of Auckland)

Pi Day

Dear colleagues,

For the last years, the International Mathematical Union (IMU) has led the project to have UNESCO proclaim March 14 (Pi Day) as the International Day of Mathematics (IDM). The IMU is pleased to announce that today the 40th General Conference of UNESCO approved the Proclamation by UNESCO of March 14 as the International Day of Mathematics.

Official launch of the IDM

Since March 14, 2020 is a Saturday, the international official launch will take place on Friday March 13, 2020. There will be two parallel international events: the first one in Paris at the UNESCO Headquarters, and the second one, an African launch, as a plenary event at the Next Einstein Forum 2020 (March 10–13, 2020) in Nairobi, Kenya.

Website of the IDM

The IDM website is https://www.idm314.org/. Countries and organizations are invited to announce their celebrations. A media page, very soon to be online, will contain material to be used by the organizers (logo and flyers in different languages). Open Source material related to the theme will also be available.

IDM theme for 2020

The theme for IDM 2020 is Mathematics is everywhere. Descriptions in several languages can be found on the website https://www.idm314.org/.

Invitation to celebrate

We invite your Adhering Organization to spread the word in your country and invite your community to celebrate at different levels: schools, public, media or national celebrations. Invitations to celebrate in several languages can be found in the media page on the website as soon as it is online.

The IMU is deeply grateful to Christiane Rousseau for taking the initiative to create the IDM, for leading the process all the way to the successful proclamation by UNESCO, as well as agreeing to chair the IDM Governing Board.

Regards,

Helge Holden

Prof. Helge Holden, Secretary General of the International Mathematical Union

NZMS NOTICES

Draft minutes of 45th Annual General Meeting of the NZMS

Massey University (Manawatu), 3rd December 2019, AH1.

Present: Boris Baeumer, Richard Brown, Alona Ben-Tal, Bruce van Brunt, John Butcher, David Bryant, Jiling Cao, Hyuck Chung, Lisa Orloff Clark, Luke Fullard, Steven Galbraith, Marie Graff, Pedram Hekmati, Shaun Hendy, Sam Irvine, Stephen Joe, Vivien Kirk (Chair), Bernd Krauskopf, Carlo Laing, Woei Chet Lim, Michael Lockyer, Tammy Lynch, Robert McLachlan, Jeanette McLeod, John Mitry, Sishu Shankar Muni, Rua Murray (minutes), Dion O'Neale, Hinke Osinga, Nicolette Rattenbury, Mick Roberts, David Simpson, Jonny Stephenson, Catherine Hassell Sweatman, Winston Sweatman, Lorenzo Toniazzi, Chris Tuffley, Graham Weir, Phil Wilson, Nicholas Witte, Wenjun Zhang.

Apologies: Florian Beyer, Kevin Broughan, Sahana Cidambi, Marston Conder, Emily Harvey, Astrid an Huef, Stephen Marsland, Charles Semple, Melissa Tacy, Graeme Wake.

Meeting opened: 5.00 pm.

1. Minutes of the 44th Annual General Meeting were accepted.
   (Moved from Chair, passed.)

2. There were no matters arising.

3. President's report. The President began by thanking Tammy Lynch and the Colloquium organising committee for an excellent conference. The President reminded members of honours achieved this year, including the election of Astrid an Huef to FRSNZ, the award of the Cranwell Medal for Science Communication to Jeanette McLeod and Phil Wilson, and Christian Offen for the Hatherton Award. Additionally, she reiterated her thanks to those members who work hard for the Society behind the scenes, including the Webmaster (David Simpson), Membership Secretary (John Shanks), NZJM editor (Shaun Cooper) and NZMS Newsletter editors (Fabien Montiel and Melissa Tacy). The President then thanked the Council, noting in particular the departing Council members.

   Members were reminded of the panel discussion on diversity in the Mathematics community, to be held following the AGM.

4. Shaun Hendy spoke briefly about international thinking on FAIR research principles (findable, accessible, interoperable and reusable) and open data. Mathematics has been slower to engage with these discussions than many science subjects. Member's attention was also directed to an article in the forthcoming Newsletter by Mark Wilson on open access publication.

5. The Treasurer's report was tabled, showing 2019 financial performance in line with budget, and setting a similar budget for 2020. Audited accounts now form part of the annual return to Charities Services, and documentation (up to and including the 2018 financial year) is publicly accessible on the Charities Services website. The Treasurer's report was accepted. (Moved from Chair, passed.)

6. Appointment of auditors. The current auditor, Nirmala Nath from the School of Accountancy, Massey University, to be re-appointed as Auditor. (Moved from Chair, passed unanimously).

7. Membership Secretary's report. This was presented (as tabled) and accepted (Murray/O'Neale).

   2019 fees to remain unchanged for 2020.

8. Election of councillors:

   (a) Emily Harvey (2014-2020) and Stephen Marsland (2017-2020) have completed their elected terms, and Shaun Cooper resigned earlier in the year; the Society thanks them for their service.

   (b) At its meeting on 2 December the Council coopted Stephen Marsland for a term of three years, with the expectation that he will continue to serve as Treasurer.

   (c) Two nominations were received for the two remaining vacancies on Council: Graham Donovan (Graff/Stephenson) and Tammy Lynch (McLachlan/van Brunt). Graham and Tammy were declared elected to Council.

9. Forthcoming colloquia:

   2020 AUT; Nov 30 - Dec 3.

   2021 Canterbury.

   2022 VUW.

   2023 Joint AMS/NZMS/AustMS meeting - Auckland to host; 4-8/12/23.

10. Julia Wolf will be the Forder lecturer, touring NZ in March 2020. Brendan Creutz is the national coordinator for the tour. Lisa Orloff Clark will be the next Aitken lecturer.

11. Correspondence: member's attention was drawn to a document from the IMU, outlining changes to the structure of the ICM that will result in a larger allocation to applied mathematics.

12. General business: members were reminded that UNESCO has declared March 14 ("Pi day") to be the international day of mathematics (see Newsletter). Members are encouraged to organise activities and liaise with each other. The Society will be building a new website for outreach.

    The meeting recorded its thanks to Vivien Kirk for her service as President, and welcomed Shaun Hendy as the new President.

Meeting closed 5.25 pm.

Next deadline for applications for Financial Assistance – 15 February (for travel commencing after March 15, 2020)

The NZ Mathematical Society has quarterly deadlines for financial assistance applications. Applications must be made well in advance (at least one month before the funded activity, but the earlier the better) and retrospective applications will not be considered. The deadlines for applications for 2020 are: 15 February, 15 May, 15 August, and 15 November. You will hear back from the Council within a month of the deadline. The types of grants are as follows.

NZMS Student Travel Grants

The NZMS invites applications from students for financial support for the presentation of research at confer- ences, attending workshops, and developing new collaborations. Typical grants for travel within NZ and Australia are in the range $200–$600. For travel further overseas, larger grants may be considered. To be eligible, a student must be based at an institution in New Zealand and be active within the New Zealand mathematical community. NZMS Student Travel Grants can contribute to costs including: flights, conference registration, accommodation, and travel-related costs associated with family responsibilities.

NZMS Student Travel Grants are generously supported by an annual grant from the Margaret and John Kalman Charitable Trust.

NZMS Financial Assistance

The NZMS invites applications for financial assistance with the costs of mathematical research-related activity. Any research-related activity will be considered. For example: hosting mathematical visitors; organising conferences, workshops, or outreach activities; and conference attendance, including costs associated with family responsibilities.

Applications

Further information and application details can be found on the NZMS website: nzmathsoc.org.nz/?assistance.

Call for applicants to attend the 8th Heidelberg Laureate Forum

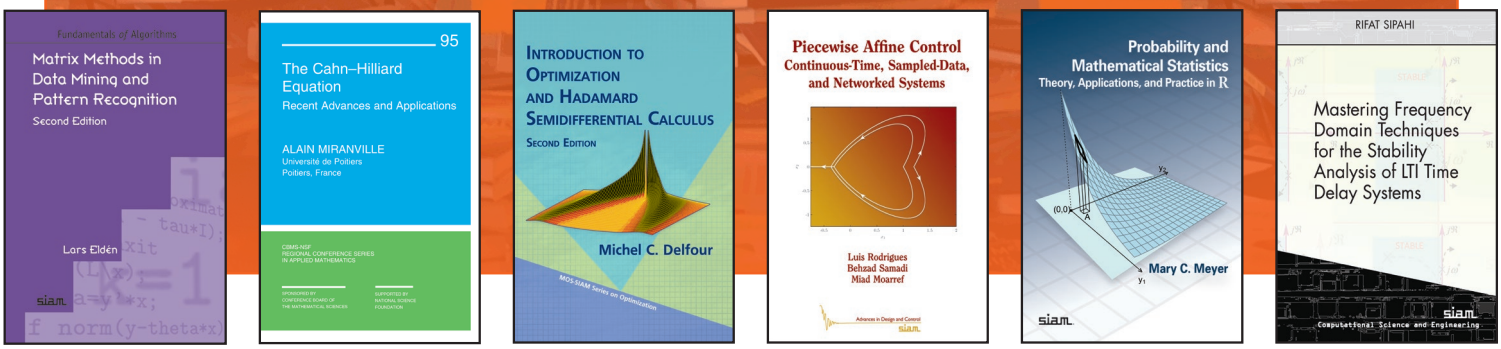
The 8th Heidelberg Laureate Forum (HLF) will take place in Heidelberg, Germany during September 20–25, 2020.

All winners of the Fields Medal, the Abel Prize, the ACM A.M. Turing Award, the Nevanlinna Prize, and the ACM Prize in Computing are invited to attend the HLF. In addition, young and talented computer scientists and mathematicians are invited to apply for participation. The HLF serves as a great platform for interaction between the masters in the fields of mathematics and computer science and young talents. The previous HLFs have been an exceptional success.

Applications for participation at the 8th HLF are open in three categories: Undergraduates, PhD Candidates, and PostDocs. See the webpage for the online application and further information. The NZMS can nominate young researchers to attend the Forum. Nominated persons get "priority treatment", but there is no guarantee that nominees will be offered a place at the Forum. If you wish to be nominated by the NZMS, email the President, Shaun Hendy shaun.hendy@auckland.ac.nz by February 1st, 2020.

The NZMS may be able to provide some travel support to enable a successful applicant to attend the HLF.

New and Notable Titles from SIAM



Matrix Methods in Data Mining and Pattern Recognition
Second Edition

Lars Eldén

This thoroughly revised second edition provides an updated treatment of numerical linear algebra techniques for solving problems in data mining and pattern recognition. Adopting an application-oriented approach, the author introduces matrix theory and decompositions, describes how modern matrix methods can be applied in real life scenarios, and provides a set of tools that students can modify for a particular application. It adds a new chapter on graphs and matrices, and a new chapter on spectral graph partitioning applied to social networks and text classification.

2019 · xiv + 229 pages · Softcover · 978-1-611975-85-7
List $69.00 · SIAM Member $48.30 · FA15

The Cahn–Hilliard Equation
Recent Advances and Applications

Alain Miranville

This is the first book to present a detailed discussion of both classical and recent results on the popular Cahn–Hilliard equation and some of its variants. The focus is on mathematical analysis of Cahn–Hilliard models, with an emphasis on thermodynamically relevant logarithmic nonlinear terms, for which several questions are still open. Many chapters include open problems and directions for future research.

2019 · xiv + 216 pages · Softcover · 978-1-61197-591-8
List $69.00 · SIAM Member $48.30 · CB95

Introduction to Optimization and Hadamard Semidifferential Calculus
Second Edition

Michel C. Delfour

This second edition builds upon its prior edition's foundation, showcasing new material linked to convex analysis and nonsmooth optimization. It presents a modern treatment of optimization and Hadamard semidifferential calculus while remaining at a level that is accessible to undergraduate students. Appropriate as both a textbook and a reference, it includes exercises related to problems in such fields as engineering, mechanics, medicine, physics, and economics along with answers.

2019 · xvi + 427 pages · Hardcover · 978-1-611975-95-6
List $99.00 · SIAM Member $69.30 · MO27

Piecewise Affine Control
Continuous-Time, Sampled-Data, and Networked Systems

Luis Rodrigues, Behzad Samadi, and Miad Moarref

This book targets controller design for piecewise affine systems, fulfilling both performance and stability requirements. It presents a unified computational methodology for the analysis and synthesis of piecewise affine controllers, and introduces algorithms that will be applicable to nonlinear systems approximated by piecewise affine systems. Examples from several areas are featured.

2019 · xviii + 224 pages · Softcover · 978-1-611975-89-5
List $89.00 · SIAM Member $62.30 · DC35

Probability and Mathematical Statistics
Theory, Applications, and Practice in *R*

Mary C. Meyer

This book develops the theory of probability and mathematical statistics with the goal of analyzing real-world data. Throughout the text, the R package is used to compute probabilities, check analytically computed answers, simulate probability distributions, illustrate answers with appropriate graphics, and help students develop intuition surrounding probability and statistics. Examples, demonstrations, and exercises in the R programming language serve to reinforce ideas and facilitate understanding and confidence.

2019 · xii + 707 pages · Hardcover · 978-1-611975-77-2
List $109.00 · SIAM Member $76.30 · OT162

Mastering Frequency Domain Techniques for the Stability Analysis of LTI Time Delay Systems

Rifat Sipahi

This multipurpose book addresses the following questions for linear time-invariant (LTI) systems with an eigenvalue-based approach that is built upon frequency domain techniques: the fundamental question of how to study the stability of dynamical systems influenced by time delays; the related issues of how much time delay the system can withstand without becoming unstable; and how to change parameters to render improved dynamic characteristics, utilize/tune delay to improve dynamical behavior, and assess the stability and speed of response of the dynamics. Readers will find key results from the literature, step-by-step demonstrations of all implementations, and Maple and MATLAB code that is available from the author's website.

2019 · xviii + 172 pages · Softcover · 978-1-611975-71-0
List $74.00 · SIAM Member $51.80 · CS20

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Order online at *bookstore.siam.org*

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